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86th Congress
2d Session } JOINT COMMITTEE PRINT

BACKGROUND MATERIAL FOR THE REVIEW OF THE INTERNATIONAL ATOMIC POLICIES AND PROGRAMS OF THE UNITED STATES

REPORT

TO THE

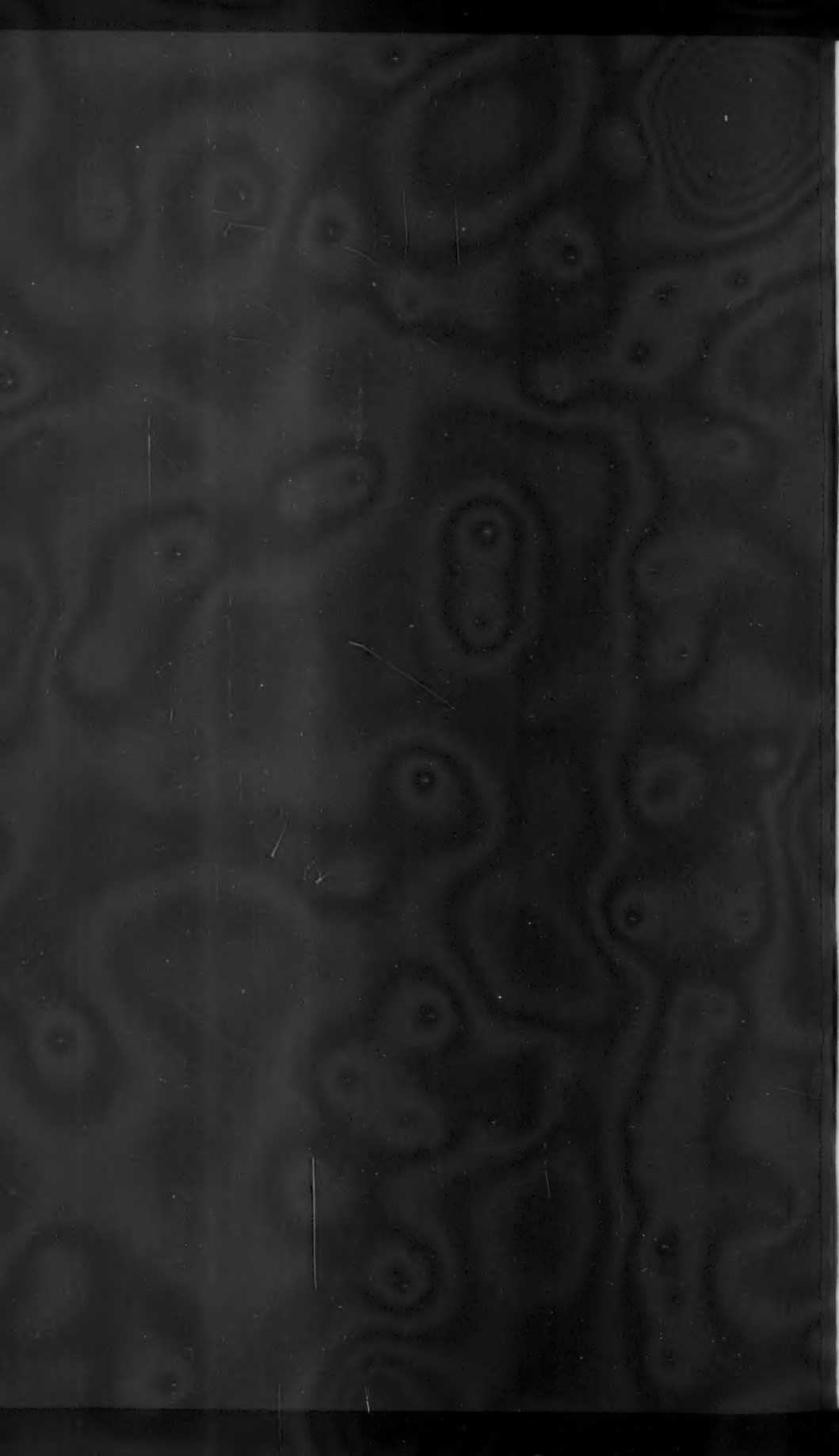
JOINT COMMITTEE ON ATOMIC ENERGY

CONGRESS OF THE UNITED STATES

VOLUME 2

OCTOBER 1960

Printed for the use of the Joint Committee on Atomic Energy



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BACKGROUND MATERIAL FOR THE REVIEW

OF THE

INTERNATIONAL ATOMIC POLICIES AND PROGRAMS OF THE UNITED STATES

By

ROBERT MCKINNEY

LETTER OF TRANSMITTAL

OCTOBER, 1960.

Hon. CLINTON P. ANDERSON,
Chairman, Joint Committee on Atomic Energy, Congress of the United States, Washington, D.C.

DEAR MR. CHAIRMAN: On September 14, 1959, you requested that I undertake for the Joint Committee on Atomic Energy a review of the international policies and programs of the United States relating to the peaceful uses of atomic energy.

The review has been completed. I take pleasure in transmitting to you herewith my report, together with the background material assembled in the course of its preparation.

I am grateful for the cooperation so freely given by governments and officials in public and private life throughout the free world, whose cooperation was essential to the conduct of this review. The assistance of the many departments and agencies of the executive branch of the U.S. Government was invaluable, as were the contributions of many private citizens and industrial organizations in the United States. I am particularly grateful for the support of the Joint Committee, its staff, and the Library of Congress.

Without the administrative assistance made available by the Atomic Energy Commission, and all the other support received, the conduct of this review would have been impossible. I should add, however, that the judgments, conclusions, and recommendations contained in Volume I of this report are those of the author, and are not necessarily those of the Joint Committee on Atomic Energy or of the executive branch of the Government.

Furthermore, although the material contained in the Background Volumes was considered by the author in the preparation of Volume I, it should not be assumed that its publication is intended to imply that the statements or opinions contained therein are subscribed to in the review or that their correctness is underwritten.

I appreciate this opportunity to serve you and the Joint Committee.

Respectfully,

ROBERT MCKINNEY.

LETTER OF TRANSMITTAL

CONTENTS

Volume 2—Background material for chapter 1: International atomic policies and programs of the United States relating to the peaceful uses of atomic energy: A historical survey: Page

Letter of transmittal v
Foreword XI
Address by President Dwight D. Eisenhower before General Assembly of the United Nations, "Atomic Power for Peace," December 8, 1953 79
"Chronology of Events Related to the Development of the Peaceful Uses of Atomic Energy Throughout the World (1939–60)," by the Review Staff 86
"U.S. Atomic Energy Commission Technical Information Foreign Exchange Programs," by the Atomic Energy Commission 111
"Utilization of Foreign AEC Depository Libraries," by the Atomic Energy Commission 190
"The Atomic Energy Commission Conference and Exhibits Program," by the Atomic Energy Commission 195
"U.S. Atomic Energy Commission Topical Conference Program Including Conferences Supported Under Section 419, Mutual Security Act, 1954, as Amended," by the Atomic Energy Commission 212
"International Training Programs of the Atomic Energy Commission," by the Atomic Energy Commission 245
"Unclassified Visits to Atomic Energy Commission Field Installations by Foreign Nationals," by the Atomic Energy Commission 300
"Radioisotope Programs," by the Atomic Energy Commission 305
"Life Science Programs," by the Atomic Energy Commission 309
"International Cooperation in Basic Research in the Physical Sciences," by the Atomic Energy Commission 330
"The Research Reactor and Equipment Assistance Programs of the United States," by the Atomic Energy Commission 335
"The Foreign Power Assistance Program," by the Atomic Energy Commission 376
"Status of the Limited Deferred Payment Plan," by the Atomic Energy Commission 418
"International Cooperation in the Peaceful Uses of Atomic Energy Through the Instrument of the Bilateral Agreement for Cooperation," by the Atomic Energy Commission 421

Volume 3 is a continuation of Background Material for Chapter 1:

"Peaceful Uses of Atomic Energy Programs in Foreign Countries," by the Atomic Energy Commission 495
"The Puerto Rican Nuclear Center," by the Atomic Energy Commission 688
"The Asian Nuclear Center," by the Atomic Energy Commission 694
"The Inter-American Nuclear Energy Commission," by the Atomic Energy Commission 708
"The International Atomic Energy Agency," by the Atomic Energy Commission 720
"Activities of the United Nations and Its Specialized Agencies," by the Department of State 762
"Activities of the Organization for European Economic Cooperation in the Peaceful Uses of Atomic Energy," by the Atomic Energy Commission 788
"The European Atomic Energy Community," by the Atomic Energy Commission and the Department of State 802
"A Brief History of Safeguards," by the Atomic Energy Commission 842

Volume 3—Continued
"Summary of Organization of Executive and Legislative Branches of Government for International Peaceful Atomic Activities," by the Review Staff ... Page 857
"Organization for Administration of the Atomic Energy Commission Program for International Cooperation in the Peaceful Applications of Atomic Energy," by the Atomic Energy Commission ... 862
"Atomic Energy Responsibilities in the Department of State," by the Department of State ... 884
"The Role of Congress in the Formation and Execution of International Atomic Policies and Programs," by the Library of Congress ... 887
"Cost Summary—Programs for Cooperation and Assistance in the Utilization of Atomic Energy in Foreign Countries and With International and Regional Organizations," by the Atomic Energy Commission ... 918
"Summary of Future Costs—Programs for Cooperation and Assistance in the Utilization of Atomic Energy With International and Regional Organizations," by the Atomic Energy Commission ... 920
"Legislation and Congressional Reports on International Atomic Energy Programs and Policies," by David R. Toll, staff counsel, Joint Committee on Atomic Energy ... 921A
Volume 4 contains background material for Chapter 2: The Growth of Atomic Research Capabilities:
"Considerations on Atomic Cooperation in Europe During the Sixties," by L. Kowarski ... 1002
"Objectives for Nationally Supported Atomic Energy Laboratories," by W. Bennett Lewis ... 1022
"Scientific Interchange, a Basis for International Understanding," by Norman Hilberry ... 1025
Volume 4 also contains background material for chapter 3: Atomic power—International status and prospects:
Section A: Atomic power ... 1031
"Status and Prospects of Central Station Nuclear Power," by Ebasco Services, Inc ... 1032
"Current Status and Potential of Various Concepts of Nuclear Reactors for Use in Central Station Generation of Electricity," by the Atomic Energy Commission ... 1147
Text of Atomic Industrial Forum questionnaire, requesting opinions on the availability of competitive nuclear power and evaluation of non-technical obstacles ... 1157
Questionnaire responses by Atomic Industrial Forum members ... 1160
"Prospective Developments in the Field of Nuclear Energy" extracted from the OEEC report entitled "Toward a New Energy Pattern in Europe" ... 1187
"Outlook for the Development of Nuclear Energy," by the European Atomic Energy Community ... 1196
Exchange of correspondence with Provinciale Noordbrabantsche Electriciteits-Maatschappij ... 1249
"A New Look at Euratom" a statement to the Joint Committee on Atomic Energy, by Robert McKinney ... 1250
"Revised Program for Nuclear Power Development," by the United Kingdom Ministry of Power ... 1262
United Kingdom Atomic Energy Authority views on the present and prospective state of civilian atomic power in the United Kingdom ... 1263
Exchange of correspondence with the U.S.S.R ... 1273
"The Atomic Energy Programs of Communist Countries," by the Review Staff ... 1276
"Atomic Energy of Canada, Limited," statement on Canada's atomic energy program ... 1365
"Atomic Energy Technology in Japan and Outlook on the Future," by the Japanese Atomic Energy Commission ... 1372
"India's Atomic Energy Program," by the Indian Atomic Energy Commission ... 1396
"Atomic Power Generation Programme (Summary)," by the Japanese Ministry of International Trade and Industry ... 1396A
"Electric Development in Italy and Nuclear Power Utilization Outlooks in the Next 10 years," by Bocconi University ... 1406
"Letter Report on Power Generation Technology," by Wade Dickinson ... 1444

Volume 4—Continued Page
Section B: Energy resources 1456
"Conventional Fuels—Consumption and Availability for 1975 and 2000," by W. C. Schroeder 1456
"Resources of Coal, Petroleum, Natural Gas, Oil Shale, and Tar Sands in the United States and Allied and Neutral Countries," by the U.S. Department of the Interior 1507
"Hydroelectric Power Resources of the United States and Allied and Neutral Countries," by the Federal Power Commission 1552
"Free World Energy, Petroleum, and Natural Gas Outlook" by a task force on the basis of industry interviews 1574
"The Price of Fuel Oil to Power Stations in Europe," by the Review Staff 1582
"Oil Fired Thermal Power Stations in Western Europe in 1965," by the Review Staff 1583
"World Tanker Outlook," by L. F. Kahle 1584
"Recent Trends in the Energy Situation," an extract from chapter II, OEEC report, "Toward a New Energy Pattern in Europe" 1585
Extract from OEEC Electricity Committee report, dated December 1959, regarding use of coal 1590
Extract from United Kingdom National Coal Board report, "Revised Plan for Coal, Progress of Reconstruction and Revised Estimates of Demand and Output" 1592
"Uranium Resources of the United States and Allied and Neutral Countries," by the Atomic Energy Commission 1598
"Thorium Resources of the United States and Allied and Neutral Countries," by the Atomic Energy Commission 1609
"Uranium and Thorium Resources of Communist Countries," by the Review Staff 1613
Extract from the United Nations report, "New Sources of Energy and Economic Development" 1619
"The Use of Tidal Energy," by R. Gibrat 1634
"A Broader Perspective Opened to the Thermal Energy of the Sea by Recent Surface Nuclear Explosion Tests," by M. C. Beau 1635
"Recent Developments in the Use of Wind Power," by E. W. Golding 1638
"The Use of Solar Energy," by F. Daniels 1640
Exchange of correspondence regarding request for information on energy sources of the U.S.S.R. 1642
"Production and Reserves of Primary Energy in the Sino-Soviet Area, 1959, 1975, and 2000," by the Review Staff 1644
"Future U.S. Energy Requirements," by the Federal Power Commission 1653
"Estimated U.S. Electrical Energy Requirements for 1975," by the Federal Power Commission 1659
Excerpt, "OEEC Forecasts of Aggregate Requirements," from chapter III, "Toward a New Energy Pattern in Europe" 1660
"Energy Forecasts for the United States and the U.S.S.R. Through 1965," from a report of visit to U.S.S.R., published by the Edison Electric Institute 1671
Exchange of correspondence with Department of State regarding energy demand forecasts for Latin America, Asia, and Africa 1678A
"Projection of Energy Demands in Latin America and Asia," by the Department of the Interior 1679
Volume 5 contains background material for chapter 4: Other peaceful atomic applications:
"Medical Uses of Atomic Energy," by John C. Bugher, M.D. 1685
"Status and Prospects for Direct Conversion of Atomic Power," by the Review Staff 1693
Status and prospects for nonpower applications of atomic energy 1695A
"The Applications of Atomic Energy Other Than Central-Station Power Generation," by the Battelle Memorial Institute 1697
"Industrial Applications of Nuclear Reactors Other Than for Central-Station Generation of Electricity," by the Atomic Energy Commission 1899
"Status of Merchant Ship Nuclear Propulsion Programs in Various Countries," by the Atomic Energy Commission 1910
"Status and Prospects for Peaceful Uses of Nuclear Explosives (Project Plowshare)," by the Atomic Energy Commission 1915

Volume 5—Continued

	Page
"Use of Radioisotopes and Radiation in Agriculture and Plant Studies," by the Atomic Energy Commission	1926
"Contribution of Atomic Energy to Agriculture," by the Department of Agriculture	1945
"Radiation Preservation of Food," by the Department of the Army	1947
"Food Preservation by Ionizing Energy," by the Office of the Quartermaster General, Department of the Army	1951
"Impact of Radioisotopes on Medical Diagnosis and Therapy," by the Atomic Energy Commission	1964
"Peaceful Uses of Atomic Energy in Public Health Programs," by the Public Health Service	1974
"Radioisotopes in Science and Industry," by the Atomic Energy Commission	1990
"Isotopic Power," by the Atomic Energy Commission	1998
"Isotopic Power," by the Martin Co. for the Atomic Energy Commission	1999
"Impact of Radioisotopes on Life Sciences," by the Atomic Energy Commission	2009
"Basic Research in the Physical Sciences," by the Atomic Energy Commission	2016
"The World Effort on Controlled Fusion," by the U.S. Atomic Energy Commission	2023
"Progress Toward Fusion Power—The U.S. Program," by the Atomic Energy Commission	2040
"European Fusion Research," report of the CERN Study Group on Fusion Problems	2049
Staff note concerning United Kingdom fusion program and excerpt from United Kingdom report on controlled fusion	2080
Staff note concerning controlled fusion in the U.S.S.R	2080

FOREWORD

Purpose

The Joint Committee on Atomic Energy has requested that facts and judgments pertaining to the current status of the international policies and programs of the United States as they relate to the peaceful uses of atomic energy be brought together, appraised, and evaluated in relation to their original premises and purposes, and that those alternative courses of action which appear to be open to those responsible for the formulation and execution of atomic policies and programs for the future be explored.

Such a review is now timely. Searching reexamination has already begun in many quarters in many nations as to whether competitive civilian atomic power is in itself an achievable near-term objective, or whether the extensive technical capabilities devoted thereto might better be directed to other purposes. The various international instruments and institutions in the peaceful atomic field and the broad objectives underlying their creation have come into question.

Other developments which make a current reappraisal timely include:

(1) The growing body of experience with more precise estimates and actual costs of reactor construction and operation both at home and abroad;

(2) Significant changes in the supply and the demand both of fossil fuels and fissionable materials;

(3) Changed prospects for an effective international safeguards system;

(4) Changed prospects for disarmament and for cooperation with the Soviet Union;

(5) Public concern with radiation hazards arising from reactor operation and the disposal of radioactive wastes.

Current pessimism about the outlook for peaceful atomic applications, especially for civilian atomic power, may be as much a product of misunderstanding as was yesterday's overoptimism. Certainly, the inherent realities of what atomic energy can do for mankind are no less today than 6 years ago. Undue pessimism could do irreparable damage. It is important, therefore, that the nations of North America and Western Europe advanced in atomic technology resurvey their positions and, if necessary, reset their courses.

Scope

The review embraces U.S. relationships with industrialized and less-developed countries, with allied countries, and with Communist-dominated countries.

In order to assemble the review in the most useful form, studies have been made of the current and prospective status of civilian atomic power, and of other peaceful atomic applications; of informed energy-resource estimates and energy-demand forecasts; and

of the evolution of the international policies and programs of the United States in the peaceful atomic field.

While the review and evaluation are concerned with all geographic areas and all atomic applications, U.S. relationships with other nations of North America and Western Europe advanced in atomic power have received the greatest attention in this presentation so that it could be organized within manageable proportions. No implication of relative priorities as to geographic regions or programs is to be construed. The importance of U.S. relationships with other areas of the free world, including the less developed countries, and with the Soviet Union is evident.

Method

Several mechanisms have been employed to insure objectivity and to uncover as many relevant details as possible, both of fact and policy consideration. Reports on the status and prospects for atomic science and technology have been reviewed, evaluated, and summarized by recognized experts, selected on the basis of competitive proposals and working under contract to the U.S. Congress. Energy resources estimates and demand forecasts have been reviewed, evaluated, and summarized by a competent authority under contract to the U.S. Atomic Energy Commission. These data have been prepared without intervention or dictation from those conducting the review or others.

More than 200 interviews have been conducted by the review staff in 14 European countries, including the Soviet Union and Poland. Through these interviews, judgments were obtained from individuals concerned with the direction of national atomic programs and laboratories, and from key officials of the principal international atomic organizations.

Requests were addressed to the Soviet Union, paralleling those addressed to other nations, and conversations were conducted in the U.S.S.R., in Western Europe, and in the United States with high Soviet officials in connection with the review and the Soviet Union's contribution thereto. The only written material provided in reply by the U.S.S.R., however, was the Russian text of a speech by V. S. Emelyanov, previously published in English in the proceedings of the 1958 United Nations Conference on the Peaceful Uses of Atomic Energy at Geneva.

Judgments were also obtained both at home and abroad from responsible government and industry officials outside the atomic field concerned with formulation of broad national and international economic, financial, and political policies, with scientific and industrial planning, and with related commercial activities. These outside judgments were obtained in order to place atomic energy in the perspective of overall national and international objectives, and to avoid confining the review to narrow atomic areas.

The assembled factual reports, evaluations and opinions have been considered and weighed in the light of discussions with senior officials of the U.S. Department of State, the U.S. Atomic Energy Commission and the Joint Committee on Atomic Energy, and with their opposite numbers in North American and European countries advanced in atomic technology.

All of the specially prepared reports, memoranda and evaluation reports assembled and carefully considered in the course of the review are reproduced in volumes 2 to 5 of this report, entitled "Background Material." Data and judgments obtained on a private basis have not been summarized, except where specific permission was obtained. Other reports and data previously published and used in the course of the review are referenced in the background material volumes and are available to the public.

BACKGROUND MATERIAL FOR CHAPTER 1: INTERNATIONAL ATOMIC POLICIES AND PROGRAMS OF THE UNITED STATES RELATING TO THE PEACEFUL USES OF ATOMIC ENERGY: A HISTORICAL SURVEY

Address by President Dwight D. Eisenhower Before General Assembly of the United Nations, "Atomic Power for Peace," December 8, 1953

Madame President, members of the General Assembly, when Secretary General Hammarskjold's invitation to address this General Assembly reached me in Bermuda, I was just beginning a series of conferences with the Prime Ministers and Foreign Ministers of Great Britain and of France. Our subject was some of the problems that beset our world.

During the remainder of the Bermuda conference, I had constantly in mind that ahead of me lay a great honor. That honor is mine today as I stand here, privileged to address the General Assembly of the United Nations.

At the same time that I appreciate the distinction of addressing you, I have a sense of exhilaration as I look upon this Assembly.

Never before in history has so much hope for so many people been gathered together in a single organization. Your deliberations and decisions during these somber years have already realized part of those hopes.

But the great tests and the great accomplishments still lie ahead. And in the confident expectation of those accomplishments, I would use the office which, for the time being, I hold, to assure you that the Government of the United States will remain steadfast in its support of this body. This we shall do in the conviction that you will provide a great share of the wisdom, the courage, and the faith which can bring to this world lasting peace for all nations, and happiness and well-being for all men.

Clearly, it would not be fitting for me to take this occasion to present to you a unilateral American report on Bermuda. Nevertheless, I assure you that in our deliberations on that lovely island we sought to invoke those same great concepts of universal peace and human dignity which are so cleanly etched in your charter.

Neither would it be a measure of this great opportunity merely to recite, however hopefully, pious platitudes.

A danger shared by all

I therefore decided that this occasion warranted my saying to you some of the things that have been on the minds and hearts of my legislative and executive associates and on mine for a great many months—thoughts I had originally planned to say primarily to the American people.

I know that the American people share my deep belief that if a danger exists in the world, it is a danger shared by all—and equally, that if hope exists in the mind of one nation, that hope should be shared by all.

Finally, if there is to be advanced any proposal designed to ease even by the smallest measure the tensions of today's world, what more appropriate audience could there be than the members of the General Assembly of the United Nations?

I feel impelled to speak today in a language that in a sense is new—one which I, who have spent so much of my life in the military profession, would have preferred never to use.

That new language is the language of atomic warfare.

The atomic age has moved forward at such a pace that every citizen of the world should have some comprehension, at least in comparative terms, of the extent of this development, of the utmost significance to every one of us. Clearly, if the peoples of the world are to conduct an intelligent search for peace, they must be armed with the significant facts of today's existence.

My recital of atomic danger and power is necessarily stated in U.S. terms, for these are the only incontrovertible facts that I know. I need hardly point out to this Assembly, however, that this subject is global, not merely national in character.

The fearful potentials

On July 16, 1945, the United States set off the world's first atomic explosion.

Since that date in 1945, the United States of America has conducted 42 test explosions.

Atomic bombs today are more than 25 times as powerful as the weapons with which the atomic age dawned, while hydrogen weapons are in the ranges of millions of tons of TNT equivalent.

Today, the U.S. stockpile of atomic weapons, which, of course, increases daily, exceeds by many times the explosive equivalent of the total of all bombs and all shells that came from every plane and every gun in every theater of war in all of the years of World War II.

A single air group, whether afloat or land based, can now deliver to any reachable target a destructive cargo exceeeding in power all the bombs that fell on Britain in all of World War II.

In size and variety, the development of atomic weapons has been no less remarkable. The development has been such that atomic weapons have virtually achieved conventional status within our armed services. In the United States, the Army, the Navy, the Air Force, and the Marine Corps are all capable of putting this weapon to military use.

But the dread secret, and the fearful engines of atomic might, are not ours alone.

In the first place, the secret is possessed by our friends and allies, Great Britain and Canada, whose scientific genius made a tremendous contribution to our original discoveries, and designs of atomic bombs.

The secret is also known by the Soviet Union.

The Soviet Union has informed us that, over recent years, it has devoted extensive resources to atomic weapons. During this period the Soviet Union has exploded a series of atomic devices, including at least one involving thermonuclear reactions.

No monopoly of atomic power

If at one time the United States possessed what might have been called a monopoly of atomic power, that monopoly ceased to exist several years ago. Therefore, although our earlier start has permitted us to accumulate what is today a great quantitative advantage, the atomic realities of today comprehend two facts of even greater significance.

First, the knowledge now possessed by several nations will eventually be shared by others—possibly all others.

Second, even a vast superiority in numbers of weapons, and a consequent capability of devastating retaliation, is not preventive, of itself, against the fearful material damage and toll of human lives that would be inflicted by surprise aggression.

The free world, at least dimly aware of these facts, has naturally embarked on a large program of warning and defense systems. That program will be accelerated and expanded.

But let no one think that the expenditure of vast sums for weapons and systems of defense can guarantee absolute safety for the cities and citizens of any nation. The awful arithmetic of the atomic bomb does not permit of any such easy solution. Even against the most powerful defense, an aggressor in possession of the effective minimum number of atomic bombs for a surprise attack could probably place a sufficient number of his bombs on the chosen targets to cause hideous damage.

Should such an atomic attack be launched against the United States, our reactions would be swift and resolute. But for me to say that the defense capabilities of the United States are such that they could inflict terrible losses upon an aggressor—for me to say that the retaliation capabilities of the United States are so great that such an aggressor's land would be laid waste—all this, while fact, is not the true expression of the purpose and the hope of the United States.

To pause there would be to confirm the hopeless finality of a belief that two atomic colossi are doomed malevolently to eye each other indefinitely across a trembling world. To stop there would be to accept helplessly the probability of civilization destroyed—the annihilation of the irreplaceable heritage of mankind handed down to us generation from generation—and the condemnation of mankind to begin all over again the age-old struggle upward from savagery toward decency, and right, and justice.

Surely no sane member of the human race could discover victory in such desolation. Could anyone wish his name to be coupled by history with such human degradation and destruction?

Occasional pages of history do record the faces of the "Great Destroyers" but the whole book of history reveals mankind's never-ending quest for peace, and mankind's God-given capacity to build.

It is with the book of history, and not with isolated pages, that the United States will ever wish to be identified. My country wants to be constructive, not destructive. It wants agreements, not wars, among nations. It wants itself to live in freedom, and in the confidence that the people of every other nation enjoy equally the right of choosing their own way of life.

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No idle words or shallow visions

So my country's purpose is to help us move out of the dark chamber of horrors into the light, to find a way by which the minds of men, the hopes of men, the souls of men everywhere, can move forward toward peace and happiness and well-being.

In this quest, I know that we must not lack patience.

I know that in a world divided, such as ours today, salvation cannot be attained by one dramatic act.

I know that many steps will have to be taken over many months before the world can look at itself one day and truly realize that a new climate of mutually peaceful confidence is abroad in the world.

But I know, above all else, that we must start to take these steps—now.

The United States and its allies, Great Britain and France, have over the past months tried to take some of these steps. Let no one say that we shun the conference table.

On the record has long stood the request of the United States, Great Britain, and France to negotiate with the Soviet Union the problems of a divided Germany.

On that record has long stood the request of the same three nations to negotiate an Austrian state treaty.

On the same record still stands the request of the United Nations to negotiate the problems of Korea.

Most recently, we have received from the Soviet Union what is in effect an expression of willingness to hold a Four Power meeting. Along with our allies, Great Britain and France, we were pleased to see that this note did not contain the unacceptable preconditions previously put forward.

As you already know from our point Bermuda communique, the United States, Great Britain, and France have agreed promptly to meet with the Soviet Union.

The Government of the United States approaches this Conference with hopeful sincerity. We will bend every effort of our minds to the single purpose of emerging from that Conference with tangible results toward peace—the only true way of lessening international tension.

We never have, we never will, propose or suggest that the Soviet Union surrender what is rightfully theirs.

We will never say that the peoples of Russia are an enemy with whom we have no desire ever to deal or mingle in friendly and fruitful relationship.

On the contrary, we hope that this Conference may initiate a relationship with the Soviet Union which will eventually bring about a free intermingling of the peoples of the East and of the West—the one sure, human way of developing the understanding required for confident and peaceful relations.

Instead of the discontent which is now settling upon Eastern Germany, occupied Austria, and the countries of Eastern Europe, we seek a harmonious family of free European nations, with none a threat to the other, and least of all a threat to the peoples of Russia.

Beyond the turmoil and strife and misery of Asia, we seek peaceful opportunity for these people to develop their natural resources and to elevate their lives.

These are not idle words or shallow visions. Behind them lies a story of nations lately come to independence, not as a result of war, but through free grant or peaceful negotiation. There is a record, already written, of assistance gladly given by nations of the West to needy peoples, and to those suffering the temporary effects of famine, drought, and natural disaster.

These are deeds of peace. They speak more loudly than promises or protestations of peaceful intent.

For the benefit of mankind

But I do not wish to rest either upon the reiteration of past proposals or the restatement of past deeds. The gravity of the time is such that every new avenue of peace, no matter how dimly discernible, should be explored.

There is at least one new avenue of peace which has net yet been well explored—an avenue now laid out by the General Assembly of the United Nations.

In its resolution of November 18, 1953, this General Assembly suggested—and I quote—

> That the Disarmament Commission study the desirability of establishing a subcommittee consisting of representatives of the Powers principally involved, which should seek in private an acceptable solution * * * and report on such a solution to the General Assembly and to the Security Council not later than 1 September 1954.

The United States, heeding the suggestion of the General Assembly of the United Nations, is instantly prepared to meet privately with such other countries as may be "principally involved," to seek "an acceptable solution" to the atomic armaments race which overshadow not only the peace, but the very life, of the world.

We shall carry into these private or diplomatic talks a new conception.

The United States would seek more than the mere reduction or elimination of atomic materials for military purposes.

It is not enough to take this weapon out of the hands of the soldiers. It must be put into the hands of those who will know how to strip its military casing and adapt it to the arts of peace.

The United States knows that if the fearful trend of atomic military buildup can be reversed, this greatest of destructive forces can be developed into a great boon, for the benefit of all mankind.

The United States knows that peaceful power from atomic energy is no dream of the future. That capability, already proved, is here—now—today. Who can doubt, if the entire body of the world's scientists and engineers had adequate amounts of fissionable material with which to test and develop their ideas, that this capability would rapidly be transformed into universal, efficient, and economic usage.

To hasten the day when fear of the atom will begin to disappear from the minds of people, and the governments of the East and West, there are certain steps that can be taken now.

Proposal for joint atomic contributions

I therefore make the following proposals:

The governments principally involved, to the extent permitted by elementary prudence, to begin now and continue to make joint contributions from their stockpiles of normal uranium and fissionable mate-

rials to an International Atomic Energy Agency. We would expect that such an agency would be set up under the aegis of the United Nations.

The ratios of contributions, the procedures and other details would properly be within the scope of the "private conversations" I have referred to earlier.

The United States is prepared to undertake these explorations in good faith. Any partner of the United States acting in the same good faith will find the United States a not unreasonable or ungenerous associate.

Undoubtedly initial and early contributions to this plan would be small in quantity. However, the proposal has the great virtue that it can be undertaken without the irritations and mutual suspicions incident to any attempt to set up a completely acceptable system of worldwide inspection and control.

The Atomic Energy Agency could be made responsible for the impounding, storage, and protection of the contributed fissionable and other materials. The ingenuity of our scientists will provide special safe conditions under which such a bank of fissionable material can be made essentially immune to surprise seizure.

The more important responsibility of this Atomic Energy Agency would be to devise methods whereby this fissionable material would be allocated to serve the peaceful pursuits of mankind. Experts would be mobilized to apply atomic energy to the needs of agriculture, medicine, and other peaceful activities. A special purpose would be to provide abundant electrical energy in the power-starved areas of the world. Thus, the contributing powers would be dedicating some of their strength to serve the needs rather than the fears of mankind.

The United States would be more than willing—it would be proud to take up with others principally involved the development of plans whereby such peaceful use of atomic energy would be expedited.

Of those principally involved the Soviet Union must, of course, be one.

OUT OF FEAR AND INTO PEACE

I would be prepared to submit to the Congress of the United States, and with every expectation of approval, any such plan that would—

First, encourage worldwide investigation into the most effective peacetime uses of fissionable material, and with the certainty that they had all the material needed for the conduct of all experiments that were appropriate;

Second, begin to diminish the potential destructive power of the world's atomic stockpiles;

Third, allow all peoples of all nations to see that, in this enlightened age, the great powers of the earth, both of the East and of the West, are interested in human aspirations first, rather than in building up the armaments of war;

Fourth, open up a new channel for peaceful discussion, and initiate at least a new approach to the many difficult problems that must be solved in both private and public conversations, if the world is to shake off the inertia imposed by fear, and is to make positive progress toward peace.

Against the dark background of the atomic bomb, the United States does not wish merely to present strength, but also the desire and the hope for peace.

The coming months will be fraught with fateful decisions. In this Assembly; in the capitals and military headquarters of the world; in the hearts of men everywhere, be they governors or governed, may they be the decisions which will lead this world out of fear and into peace.

To the making of these fateful decisions, the United States pledges before you—and therefore before the world—its determination to help solve the fearful atomic dilemma—to devote its entire heart and mind to find the way by which the miraculous inventiveness of man shall not be dedicated to his death, but consecrated to his life.

Chronology of Events Related to the Development of the Peaceful Uses of Atomic Energy Throughout the World (1939-1960)

This chronology has been compiled from published sources, including various periodical indexes available in most public libraries. The purpose of this chronology is primarily to provide a perspective on the evolution of policies and programs relating to peaceful atomic research and application.

1939

January	-Confirmation and interpretation in U.S. of discovery of fission of uranium abroad in November 1938.
October	-President Roosevelt apprised of potentialities of uranium fission; appointed "Advisory Committee on Uranium."

1940

April	-Soviet Academy of Sciences appointed "Special Committee for the Problem of Uranium" marking initiation of atomic energy effort.
	-American scientists proposed voluntary censorship on atomic matters.
May	-Isolation of U-235 announced by A. O. Nier of U.S.
June	-Advisory Committee on Uranium placed under National Defense Research Council.

1941

May	-E. O. Lawrence reported plutonium (discovered late in 1940) is formed by neutron capture and two successive changes in atomic structure of uranium-239, and that plutonium undergoes fission.
July	-First graphite and uranium lattice structure set up at Columbia University to study neutron emission.
	-Invasion of USSR by German Army halted work on Soviet atomic energy program.

November -Review Committee reported favorably on possibility of an atomic bomb of great strength and estimated between three and four years needed to produce a bomb. Dr. Vannevar Bush and associates decided that possibilities of the atomic bomb justified greater effort and that the existing NDRC set-up was not equipped to handle such a program. Responsibility transferred to the Office of Scientific Research and Development.

December -Top Policy Group recommended further fundamental research and engineering planning of pilot plants and that the Army should be brought in when full scale construction was ready to start. Dr. Conant, following recommendations of the Top Policy Group, emphasized that an all out effort at this time was justified by the military value of atomic bombs and that all efforts must be concentrated in this direction.

1942

January -Columbia and Princeton groups moved to University of Chicago; Lawrence continued electromagnetic isotope separation methods study at University of California; research on gaseous diffusion method continued at Columbia; centrifuge work continued at University of Virginia and Standard Oil Development Laboratory in Bayway, New Jersey; Navy continued research on thermal diffusion method.

June -Bush and Conant sent a report to Top Policy Group stressing that there were four equally promising methods of separating the U-235 from U-238, and that the Army should now be brought into the project; President Roosevelt initialed and approved this report on June 17, 1942.

-Colonel J. C. Marshall, Corps of Engineers, instructed to form a new district in the Corps of Engineers labeled for security purposes the DSM Project (Development of Substitute Materials).

August -The Manhattan District was officially established and designated.

September -Army General Leslie R. Groves placed in charge of DSM Project.

September	-A Military Policy Committee was named, consisting of Dr. Bush, Dr. Conant, General Styer, Admiral Purnell and General Groves.
	-Oak Ridge, Tennessee, selected as site for Clinton Engineer Works.
November	-Los Alamos, New Mexico, selected as bomb development site.
December	-First nuclear chain reacting pile at the Metallurgical Laboratory at the University of Chicago achieved criticality.
	-First separation of Plutonium-239.
	-Hanford, Washington, selected as plutonium production site.

1943

March	-Operation of first production plant for the separation of U-235 (electromagnetic plant at Oak Ridge).
August	-Hanford production reactor construction started.
September	-Oak Ridge gaseous diffusion separations plant construction started.
November	-Oak Ridge reactor (Clinton pile) was put into operation.
December	-Chemical separation of first irradiated reactor slugs begun at Oak Ridge.

1944

January	-First U-235 from electromagnetic process at Oak Ridge shipped to Los Alamos.
March	-First plutonium delivered by Oak Ridge.
May	-Initial operation of Chicago heavy water reactor (CP-3).
July	-Oak Ridge thermal diffusion separations plant construction started.

September -First Hanford reactor started operating.

1945

February -First unit of Oak Ridge gaseous diffusion plant in operation.

July -First atomic explosion, Alamagordo, New Mexico.

August -Publication of "Smyth Report" describing Manhattan Project.

September -First reactor outside the United States went into operation at Chalk River, Canada.

October -President Truman asked Congress for domestic control legislation, announcing proposed discussions with British and Canadians (wartime partners in bomb development) for international control of atomic energy.

-Special Committee on Atomic Energy established by U.S. Senate.

November -Molotov announced USSR's intention to proceed with nuclear energy program.

-Declaration on atomic energy by President Truman, Prime Minister of U.K. and Canadian Prime Minister.

1946

January -U.N. Atomic Energy Commission established.

February -Manhattan Project Committee on Declassification submitted report.

March -Report on atomic energy by State Department's Committee on Atomic Energy (Acheson-Lilienthal report).

April -Plans for power reactor project for Oak Ridge announced.

May -Knolls Atomic Power Laboratory was established.

June -Bernard Baruch presented the U.S. proposal for international control of atomic energy to the United Nations.

-Radioactive isotopes available for research from reactor operation at Oak Ridge.

July	-Argonne National Laboratory opened to continue work of Metallurgical Laboratory established in 1942.
	-U.S. demonstration test of atomic weapon on Bikini Atoll in Pacific in presence of foreign observers, including Soviet Bloc representatives.
August	-Atomic Energy Act of 1946 signed by President Truman.
	-Brookhaven National Laboratory operating contractor, Associated Universities, Inc., established to operate on site of former Camp Upton, New York.
	-Atomic Energy Control Board was established in Canada.
October	-U.S. Atomic Energy Commission appointed by President Truman; David E. Lilienthal, Chairman.
November	-First fast neutron reactor in world started operation at Los Alamos.
December	-Drastic curtailment of operation of electromagnetic separations plant announced.

1947

January	-Transfer of atomic energy program from Manhattan District to AEC.
Spring	-First reactor in USSR went into operation.
August	-First British atomic reactor started operation.
September	-Foreign distribution of isotopes announced by President Truman (29 isotopes, 20 elements available); (by end of June 1948, 19 nations qualified to receive shipments; 15 had received a total of 159 shipments) - on undertaking to report semi-annually.
November	-First declassification of atomic energy information by U.S. AEC.

1948

March	-Oak Ridge National Laboratory officially established to continue work of the Clinton Laboratories established in 1943.

May -Ames Laboratory officially established to continue metallurgical research started in 1942.

December -U.S. inter-agency export control groups augmented by U.S. AEC representatives.

-First reactor on continental Europe outside the USSR went into operation at Chatillon, outside Paris, France.

1949

May -National Reactor Testing Station (NRTS) site selected in Idaho.

August -USSR detonated its first nuclear device.

November -U.S. and U.K. representatives discussions with the Union of South Africa "on problems relating to the eventual production of uranium."

1950

January -Thermonuclear weapons program expansion development announced by President Truman.

-Arraignment of Klaus Fuchs in U.K. for atomic espionage for Soviet Union.

December -Announcement of South African, U.S., U.K. ore-buying agreement. South African ore plants under construction.

1951

January -Construction started on Savannah River plant.

July -U.S. Atomic Energy Act of 1946 amended to permit limited international cooperation.

-First international joint project reactor began operating at Kjeller, Norway, using Norwegian heavy water and Dutch uranium.

December -First electric power generated from atomic energy in Experimental Breeder Reactor No. 1.

December -First Joint Congressional Atomic Energy Committee print on atomic energy and private enterprise.

1952

March -Materials Testing Reactor started operating at Idaho National Reactor Testing Station.

April -Homogeneous Reactor Experiment No. 1 started operating at Oak Ridge.

October -First uranium recovery plant in South Africa in operation.

-First evidence of breeding of fissionable materials in the Experimental Breeder Reactor No. 1.

December -Argonne Cancer Hospital completed at Chicago.

1953

March -Submarine Thermal Reactor Prototype achieved criticality at National Reactor Testing Station in Idaho.

December -President Eisenhower proposed to UN Assembly an international atomic energy agency to supervise application of atomic energy for peaceful purposes; asked nations principally involved in atomic arms race to contribute from stockpiles of fissionable materials.

1954

February -President Eisenhower proposed legislative amendments to Atomic Energy Act of 1946 to permit freer exchange of U.S. data with Allies; asked for an exchange of information on tactical weapons and peaceful uses of atomic energy; release of atomic materials for research and industrial use; urged role for private U.S. companies in development abroad.

March -Construction of nation's first full-scale power plant to be built at Shippingport, Pennsylvania, and to be operated by Duquesne Light Co. announced by USAEC.

-Joint Committee Chairman Cole said U.S. possessed deliverable H-bomb.

March	-U.S. AEC Chairman Strauss reported time approached when U.S. could divert more effort to peaceful uses.
April	-U.S. released films of "Operation Ivy" bomb tests to reveal magnitude of power of mass destruction weapons.
	-U.S. AEC Chairman Strauss announced plans for an international technical conference on peaceful uses of atomic energy (First Geneva Conference) in speech at Los Angeles World Affairs Council.
May	-USSR rejects encouragement of peaceful uses of atomic energy without prior weapons plan.
June	-First Soviet power reactor experiment went into operation, capable of producing 5 MW electricity.
	-President Eisenhower and U.K. Prime Minister Churchill pledged to promote conditions conducive to peaceful development of atomic energy.
August	-President Eisenhower signed Atomic Energy Act of 1954. U.S. announced determination to press for wider application of peaceful uses of atomic energy despite USSR opposition.
September	-Shippingport power reactor site ground breaking ceremony.
	-Initiation of negotiations on bilateral agreements for cooperation announced.
October	-U.N. Sec. Gen. Hammarskjold appointed committee under Dr. Bunch to study U.N. role in First Geneva Conference.
November	-Joint Committee on Atomic Energy, U.S. Congress, began six-week tour of New Zealand, Australia, the Far East, Southeast Asia, the Middle East, and Spain to gather information on efforts being made to apply peaceful uses of atomic energy; Atomic Commission in Thailand organized to receive Committee.
	-U.S. plan for international agency, scientists conference, U.S. training schools in energy's peaceful uses, and offer of technical libraries to cooperating libraries presented to U.N. General Assembly.

November -First pledge of atomic materials (220 lbs.) by USAEC announced in UN for use in experimental reactors outside the U.S.

December -International Atomic Energy Agency creation and First Geneva Conference unanimously approved by UN General Assembly.

-Australian ore processing plants started operation.

1955

January -USSR announced intention to aid atomic development in Communist China, Poland, Czechoslovakia, Rumania and East Germany; to exchange material, equipment, data for "raw materials."

February -U.S. sold 10 tons of heavy water to India.

-British Government announced plans to build 12 nuclear power plants in 10 years; initial capacity to be 1,400,000 to 2,000,000 KW.

-U.K. announced plans to manufacture bomb.

March -Argonne Nuclear Science and Engineering School organized and opened to foreign students (first class included 31 students from 10 foreign nations).

April -Curbs on manufacture of power reactors for shipment abroad lifted by U.S.; move intended to spur activity abroad by U.S. companies.

-USSR to supply reactors to Soviet bloc nations and Communist China.

-USSR signed first bilateral agreement providing for "research" equipment and other assistance to Rumania.

-President Eisenhower announced plan to build atomic powered merchant ship to tour world with exhibits.

May -First special radioisotope techniques course at Oak Ridge Institute for Nuclear Studies for students from other nations.

-Representatives of Benelux, France, Germany and Italy, proposed creation of European Atomic Energy Community.

May

-U.S. completed first "research" Agreement for Cooperation with Turkey, allocating U-235 for shipment abroad for first time.

-U.S. sale of swimming pool research reactor to Swiss after display at First Geneva Conference announced.

-Atomic Industrial Forum reported private industry would spend $300 million during next four years on research.

-Private industry access to U.S. secret atomic data for development of peaceful uses of atomic energy announced.

June

-President Eisenhower urged U.S. offer to pay up to one half the cost of research reactors and provide atomic fuel to free world nations; proposed technical aid to nations willing to build commercial power stations.

-First "comprehensive" power and research agreements signed with Belgium, Canada and the U.K.

-25 doctors from 12 nations toured AEC atomic installations, hospitals and universities.

-U.S. proposed collation of data from all nations on radiation effects under U.N. auspices.

-President Eisenhower designated another 220 lbs. of U-235 for use by other countries in cooperative program, raising total contribution to 440 lbs.

July

-Soviet bloc scientists held conference on peaceful uses in Moscow.

-First free world scientists visited Soviet atomic power station at Obninsk.

-President Eisenhower approved gift of a research reactor to Government of the Philippines.

-First commercially distributed atomic electric power for public use (from prototype of "Sea Wolf" submarine reactor at West Milton, N.Y.).

July	-International Atomic Energy Agency statute draft prepared and agreed upon by an eight-nation group in Washington.
	-Shipment of 23 U.S. technical libraries to other nations announced.
August	-First U.N. International Conference on Peaceful Uses of Atomic Energy held at Geneva August 8-20. U.S. schedule of prices for lease or sale of uranium and sale of heavy water announced.
	-Representatives of U.S., USSR, U.K., France, Canada and Czechoslovakia studied technical aspects of safeguarding nuclear materials.
September	-USAEC lifted ban on export of atomic energy equipment; Commerce Department to keep ban on shipments to Soviet bloc.
October	-American firms authorized by AEC to engage in unclassified foreign atomic energy activities without prior approval.
	-Far Eastern regional atomic center for economic development with U.S. support proposed to Colombo Powers Assembly in Singapore; U.S. to provide reactors, other facilities.
November	-USAEC established Division of International Affairs to coordinate Commission's role in international activities.
	-Bulganin offered to share atomic experience with India; Indian Vice President said India must attain goals in own way.
	-Baghdad Pact conference welcomed Secretary Macmillan offer of British help in peaceful application.
December	-U.N. General Assembly approved holding of a Second Geneva Conference in two or three years. Endorsement by U.N. Assembly of the efforts toward establishment of International Agency.
	-OEEC special committee proposed OEEC Minister's Council appoint steering committee for nuclear energy to promote joint projects among members.

December -Two years after President Eisenhower's speech to the U.N., U.S. had 22 agreements for cooperation in effect; 36 technical libraries had been presented to cooperating nations.

1956

January -Tripartite Nuclear Cross Sections Committee, comprising representatives of U.S., U.K. and Canada, established.

-French reactor, G-1, first power reactor on European continent outside USSR, went into operation.

February-June -Atomic energy potential in Asia surveyed by team of Brookhaven scientists.

February -President Eisenhower announced U.S. offer of 20,000 kgs. of U-235 for peaceful use by other countries under bilateral agreements for cooperation.

March -U.S. reported Asian nuclear center would be in Philippines.

-Eleven Communist countries agreed to set up joint research institute at Dubna in USSR.

April -Euratom plan approved by representatives of France, Germany, Italy, and Benelux countries.

-Soviet scientist I. V. Kurchatov reported in U.K. on progress on controlled fusion in USSR.

May -First U. S. letter of commitment for a $350,000 research reactor grant presented to Brazil.

June -USSR signed first bilateral agreement, providing for assistance in construction of nuclear power plants, with East Germany.

-First U.S. atomic assistance mission toured South America.

-U.K. and Canada signed long-term agreements for cooperation with U.S.

-Armour Research Foundation reactor, first in U.S. exclusively for industrial research, in operation in Chicago.

July	-OEEC created Steering Committee for Nuclear Energy.
	-President Eisenhower proposed Organization of American States Committee to study cooperation in industrial and other atomic applications.
	-First atomic-powered civilian ship authorized by Congress and President Eisenhower.
October-November	-First exchange of representatives under U.S. Argonne National Laboratory-U.K. Harwell Chemistry Personnel Exchange initiated on a classified, continuing basis.
October	-AEC and Export-Import Bank of Washington announced agreement to assist construction of atomic power plants in countries which enter into agreements for cooperation with the U.S.; loans made possible to privately-owned utilities in other countries.
	-First atomic power station, Calder Hall, in U.K. inaugurated.
	-81 nation conference unanimously approved International Atomic Energy Agency statute. (80 nations signed statute during the following three months.) President Eisenhower announced offer to the International Atomic Energy Agency of 5,000 kgs. U-235 and the matching of allocations by all other members through June 30, 1960.
November	-Belgian and U.S. scientists held power reactor technology symposium at Mol, Belgium.
December	-AEC announced plans for establishment of program for representation overseas.
	-Revision of Tripartite Declassification Guide declassified large volume of secret data on nuclear power technology.
	-Total number of U.S. agreements for cooperation reached 32, including 4 providing for nuclear power assistance.

1957

January	-First research reactor in free Asian nation operated at Trombay by Indian Atomic Energy Establishment.

January -First AEC-sponsored bilingual atomic energy symposium held at Puerto Rico University.

-Second USSR "power" bilateral agreement signed with Czechoslovakia.

February -Three Euratom "Wise men" began tour of U.S. atomic installations.

-U.S. Nautilus submarine completed operation on its first fuel core, having traveled 62,560 nautical miles in more than two years.

-Euratom atomic power project support pledged by U.S. to supply technicians and data immediately, nuclear fuel later.

March -British atomic power program tripled to 5,000-6,000 megawatts by 1965 ($2,573,299,000 program).

-President Eisenhower urged early Senate ratification of International Atomic Energy Agency statute.

-Representatives of Belgium, France, Germany, Italy, Luxembourg and the Netherlands signed treaty establishing European Atomic Energy Community (EURATOM).

-Opening of Baghdad Nuclear Training Center.

April -President Eisenhower signed amendment to Atomic Energy Act of 1954 to allow for cooperation with City of West Berlin.

-First power reactor sold abroad by U.S. firm. Belgian press announced contract with Westinghouse for purchase of 11.5 MW power reactor.

May -USSR, Byelorussia and Rumania ratified International Atomic Energy Agency statute.

-Three Wise Men committee issued report urging 15 million kilowatts electric capacity with atomic power for 10-year program.

-Inter-American Symposium on the Peaceful Application of Atomic Energy opened at Brookhaven National Laboratory.

-Japan and U.S. Atomic Industrial Forums sponsored conference on industrial uses of nuclear energy in Tokyo.

May	-Japanese, Republic of China and the Philippines atomic energy problems surveyed by U.S. AEC atomic assistance mission.
	-U.K. exploded H-bomb at high altitude in Christmas Island area, making U.K. world's third H-bomb power.
June	-U.K. AEA offered to exchange Calder Hall atomic power plant information with the U.S. AEC.
	-U.S. Senate ratified International Atomic Energy Agency establishment.
July	-President Eisenhower raised total of U-235 available for peaceful purposes abroad to 50,000 kilograms.
	-50 Euratom industrialists start survey of U.S. atomic program to study merits of various types of power reactors.
August	-100,000th shipment of radioisotopes from Oak Ridge National Laboratory.
	-First reactor in Far East became critical: JRR-1 at Tokai-Mura, Japan.
September	-First reactor became critical in South America; University of Sao Paulo research reactor in Brazil.
October	-First General Conference of International Atomic Energy Agency in Vienna; 59 member countries; former Joint Committee Chairman Cole appointed Director General.
	-AEC and University of Puerto Rico signed contract for operation of a nuclear training center in Puerto Rico to be constructed by the Commission.
	-Windscale accident; large reactor in U.K. contaminated countryside; U.S. AEC sent three teams to the U.K. in December and January 1958.
November	-Unclassified conference on fuel technology held in Paris under joint U.S.-French sponsorship; OEEC nations, Canada and Israel participated.
	-Council of Organization of American States (OAS) formally approved formation of an Inter-American Nuclear Energy Commission within OAS.

December -Shippingport pressurized water reactor started operating 45 months after announcement of project; first large scale commercial atomic plant to generate electricity for commercial use.

-17 nations, including 6 in Euratom, set up European Nuclear Energy Agency under OEEC.

-Year-end total showed 39 agreements for cooperation in effect providing for assistance to 37 other nations and West Berlin; 7 research reactor grants and 68 libraries of peaceful atomic literature approved.

1958

January -Formal inauguration of European Atomic Energy Community (Euratom).

-First payment of $350,000 U.S. reactor grant made; research reactor in Sao Paulo, Brazil.

February -European Nuclear Energy Agency (ENEA) officially established within OEEC.

-Four-week radioisotopes courses initiated by U.S. AEC at American University in Beirut, Lebanon, and at National Polytechnic School in Quito, Ecuador.

March-April -Five man AEC technical mission visited New Zealand to discuss atomic energy problems.

March -Joint U.S.-Euratom working party opened discussions on a program of cooperation.

April -First direct conversion of nuclear reactor heat into electricity achieved at Los Alamos Scientific Laboratory of U.S. AEC.

-U.S.-supplied gamma field and radioisotope laboratory for the Inter-American Institute of Agricultural Science at Turrialba, Costa Rica, dedicated.

-Commercial power generated for first time in Western Europe from nuclear reactor at Marcoule, France.

April -AEC announced liberalization of conditions under which uranium reactor fuel enriched to more than 20 percent in uranium-235 may be made available to cooperating nations.

May -IAEA team departed for Latin America to survey nuclear energy training needs and capabilities.

-U.S. sponsored peaceful atomic library workshop in Geneva attended by representatives from 20 countries and international organizations.

June -Memorandum of understanding signed by U.S. and Euratom officials incorporating the comprehensive 1,000,000 kilowatt joint program for atomic power.

-OAS-sponsored symposium opens in Buenos Aires.

-First reactor in Africa started operation at the University of Louvanium in Belgian Congo.

-U.N. Scientific Committee on the Effects of Atomic Radiation unanimously approved adoption of report on biological effects of radiation.

-"Halden" reactor joint project agreement signed by five OEEC member countries and Euratom.

-Fifth International Electronic and Nuclear Congress and Exhibition at Rome, Italy; U.S. received prize for best exhibit.

-President Eisenhower approved joint U.S.-Euratom program and sent proposed legislation to Congress.

-Sixteenth research reactor grant for $350,000 committed by U.S. to Norway.

-International Atomic Energy Agency membership reaches 67 countries.

-41 U.S. agreements for cooperation are in effect with 35 countries and the City of West Berlin, 39 for research and 12 for power.

June

-First U.S. equipment grants approved, for "package" laboratories valued at $168,000 to Italy, Greece and Uruguay.

-First Communist China research reactor reported in operation.

August

-Availability of up to 260 grams of plutonium for use in research facilities under individual U.S. agreements for cooperation announced.

-Oak Ridge Multicurie Fission Products Pilot Plant began operation.

-Nautilus completed voyage under polar ice at North Pole and 1830 mi. of ice cap.

-U.N. Scientific Committee on the Effects of Atomic Radiation reported fallout from weapons tests is genetic peril to man, but stressed radiation doses are small.

-U.S. policy for lease or sale of heavy water for use in domestic or foreign research, medical or testing reactors announced. Heretofore, heavy water was available only on a sale basis.

September

-Second Geneva Conference on the Peaceful Uses of Atomic Energy, emphasizing progress to date on fission and fusion research.

-U.S.-U.K. Agreement for closer technical contact in specific fields through appointment of "cooperation experts" on each side to serve as special channels for communication and coordination.

-Second IAEA General Conference of International Atomic Energy Agency held in Vienna; U.S. offered financial support for research projects with a total value of up to $250,000 to be carried out in member states under contracts. First of two mobile radioisotope laboratories offered by U.S. presented to the Agency.

-First country, Japan, submitted request to Agency for assistance in acquiring material (3 tons of natural uranium) for fuel fabrication and indicated willingness to accept Agency-administered safeguards.

October -First major research reactor starts operating in Spain; U.S. grant of $350,000.

November -First U.S. license for export of a nuclear power reactor (to Belgium).

-U.S.-Euratom agreement for cooperation signed; provided for sharing technical experience; U.S. pledged $135 million loan and enriched uranium for 20 years in support of joint program; limited to reactor types carried to advanced stage of development in U.S.; research and development program limited to types of reactors approved for construction.

December -Project for Asian Nuclear Center postponed indefinitely due to lack of agreement among prospective participants.

-Training program established at Shippingport Nuclear Power Station by AEC for supervisory personnel of organizations in the U.S. and other countries involved in work closely related to nuclear power plants.

-AEC and Euratom invited joint research and development proposals under the Joint Program.

-42 U.S. agreements for cooperation on peaceful atomic applications with 40 other countries and West Berlin in effect; 16 research reactor grants and three equipment grants approved for other countries; 29 research, training and testing reactors built or under construction by U.S. manufacturers in other countries.

1959

January -Japanese request for three tons of natural uranium from the Agency met by Canada free of cost.

February -AEC announced the availability of a limited deferred payment plan for enriched fuels for power reactors built abroad.

-Agreement for cooperation between the United Kingdom and Euratom went into effect.

-U.S.-Euratom Agreement for Cooperation on Joint Nuclear Power Program became effective.

March -Twelve European countries signed an agreement to cooperate in the "Dragon" Project in the U.K. organized by European Nuclear Energy Agency of OEEC.

April -U.S. and Euratom invited nuclear power reactor proposals under the Joint Program.

-$600,000 U.S. contribution toward construction cost of an analytical laboratory accepted by International Atomic Energy Agency.

-Tripartite Nuclear Cross-Sections Committee (U.S., U.K., and Canada) agreed to limited cooperation with a similar European group to be organized.

May -U.S. exhibit, including an operating training reactor, shown at International Trade Fair in Tokyo.

-Agreement for cooperation with the U.S., U.K., and the USSR signed by International Atomic Energy Agency.

-AEC sponsored technical information meeting on the construction, operation and use of test reactors at the NRTS for approximately 400 participants from the Agency, Euratom, OEEC, OAS, and other countries.

June -Second Inter-American Symposium on the Peaceful Uses of Atomic Energy held at Buenos Aires, supported by grant from Mutual Security funds of U.S.

-AEC and Euratom defer deadline from September 1, 1959, to October 20, 1959, for submission of definitive proposals for power reactors under the Joint Program.

-Institute of Nuclear Science of Central Treaty Organization, formerly known as the Baghdad Pact Nuclear Training Center, relocated and formally opened in Teheran.

-Thailand given U.S. commitment of $350,000 research reactor grant toward $1,122,000 project.

July -AEC adopted policy of making available on a sale or lease basis, uranium enriched up to 90% for use in subcritical assemblies and reactor experiments.

July	-15 tons of heavy water leased to India by U.S.
	-Savannah launched by U.S. as the world's first nuclear powered merchant ship.
	-Euratom and Italian Government initialed an agreement for the Ispra Nuclear Research Center to be transferred to Euratom as the first Community research center; approval by Italian Parliament required; the U.S. had earlier provided a $350,000 grant for the Ispra research reactor.
July-August	-Vice Admiral H. G. Rickover visited Soviet atomic energy facilities and participated in discussions with Professor V. S. Emelyanov regarding future U.S.-USSR atomic energy cooperation.
August	-Euratom and the Export-Import Bank signed an agreement implementing the Bank's $135 million line of credit to assist in financing nuclear power plants under the joint U.S.-Euratom program.
September	-AEC Chairman John A. McCone discussed with Professor V. S. Emelyanov of the USSR during a U.S. visit, ways and means of making available to other countires their respective country's research and development accomplishments on the peaceful uses of atomic energy.
September-October	-Third General Conference of International Atomic Energy Agency held in Vienna; Austria requested reactor fuel from the Agency; U.S. increased its offers of equipment and enriched uranium to the Agency.
October	-Euratom and Canada signed an agreement for cooperation providing for a five-year, $10 million program of research and development on heavy-water moderated reactors.
	-Chairman John A. McCone and four U.S. scientists and engineers toured atomic energy facilities of the USSR.
	-U.S.-Euratom received one definitive proposal under the April 13, 1959, invitation (from SENN in Italy) for construction of a 150 MW(e) nuclear power reactor.

October -Spanish heavy water production plant started operating (1.1 metric tons per year).

November -Spanish uranium production plant started operating (10 tons of uranium metal per year).

-The International Bank for Reconstruction and Development announced a loan agreement had been consummated with SENN in Italy for a $40 million loan toward the cost of a 150 MW(e) atomic power plant to be constructed by an American firm.

-Radioisotopes techniques course for 15 students from 6 Southeast Asian countries and 11 Japanese nationals co-sponsored by the Japan Radioisotopes Institute and the International Atomic Energy Agency.

-Professor V. S. Emelyanov led a party of Soviet scientists visiting unclassified atomic energy facilities similar to those visited by the U. S. mission to the USSR in October.

-International Atomic Energy Agency advisory panel completed review of the safety aspects of a proposed Swiss reactor -- the first such review requested of the Agency.

-International Atomic Energy Agency radioisotope techniques course, co-sponsored by the Argentine AEC, drew 23 students, 8 of these from other Latin American countries.

-Inter-American Symposium on Legal and Administrative Problems Related to Atomic Energy held in Puerto Rico under the sponsorship of the University of Puerto Rico and the Pan American Union.

-Expanded U.S.-U.K. cooperation in the exchange of gas-cooled reactor technology agreed.

-Chairman John A. McCone and V. S. Emelyanov of the USSR signed memorandum of cooperation covering exchanges of visits and information in specific areas on the peaceful uses of atomic energy.

December

-International Atomic Energy Agency advised U.S. will provide uranium enriched up to 90% to meet the Austrian request to the Agency for assistance in obtaining the material.

-Finland requested the Agency to provide enriched uranium for a research reactor to be purchased from the U.S.; U.S. agreed to provide the material requested.

-U.S. sponsored an exhibit emphasizing "Atoms on the Farm," at the New Delhi World Agriculture Fair.

-Year-end compilation showed 44 U.S. agreements for cooperation in effect with 42 countries and West Berlin (31 for "research" and 13 for "power" assistance); Agreements were also in effect with Euratom and the International Agency; 416 foreign nationals participated in the nine courses of the International School of Nuclear Science and Engineering at Argonne since its establishment in March, 1955; 1061 foreign nationals visited USAEC field installations in 1959; 26 foreign nationals from 9 countries attended courses of the N.S. Savannah Observation Program at Camden, N.J.; total number of technical libraries sent abroad reached 83 presentations to 58 countries and 5 international organizations; 19 commitments for reactor grants, totaling $6,650,000, had been made to date.

1960

January

-International Atomic Energy Agency and UNESCO sponsored international training course on radioisotopes techniques in New Delhi, India.

-U.S.-Euratom determined that the SENN proposal for construction of a 150 MW(e) nuclear power reactor complied with provisions of the 1959 invitation.

February

-France detonated first nuclear device, making the fourth atomic weapons power.

-First mobile radioisotope laboratory donated to the International Agency by the U.S. was shipped to Korea for use in courses on medical and agricultural uses of isotopes.

February

-International Atomic Energy Agency concluded an agreement with the Yugoslav Nuclear Energy Commission for a joint dosimetry experiment related to an accident at the Yugoslavia laboratory to be carried out in Yugoslavia under Agency auspices.

-The European Organization for Nuclear Research (CERN) officially inaugurated the world's largest accelerator, a 25 billion electron volt proton synchrotron, near Geneva.

-USAEC approved a cooperative program with the Canadian AEC on the development of heavy-water moderated power reactors.

March

-Seven-man U.S. team visited India for a tour of atomic energy and other facilities, and for discussions on a possible joint U.S.-Indian cooperative nuclear power program.

-Exchange of detailed information on high temperature gas-cooled reactors agreed by USAEC and UKAEA.

May

-U.S. delegation visited Yugoslavia to discuss matters of mutual interest including atomic energy coooeration through the International Agency.

-U.S. held an atomic energy exhibit in Cairo.

-U.S. and USSR initiated exchange of technical visits provided for under November 1959 memorandum of cooperation signed by Chairman McCone and Professor Emelyanov.

-International Agency-sponsored radioisotopes course in medicine and agriculture held at the University of Louvanium in the Belgian Congo.

-Negotiations completed on the gift to the Government of India of a fly-rearing and sterilization facility, and a cobalt-60 gamma irradiation facility used in the U. S. exhibit in New Delhi's World Agricultural Fair.

-USAEC authorized its facilities to reprocess for foreign countries degraded heavy water originally purchased from the AEC; this action was expected to assist operators in improving reactor efficiency and reducing the cost of replacing heavy water.

LETTER OF REQUEST FROM REVIEW STAFF TO ATOMIC ENERGY COMMISSION AND DEPARTMENT OF STATE

This will confirm our discussion concerning summaries of the record on international atomic assistance programs and institutions.

It is agreed that the Atomic Energy Commission and the Department of State should collaborate in the manner they find most appropriate in the preparation of these papers. For purposes of clarification, the following is a restatement of the specific items covered * * *

1. Atomic power assistance programs.
2. Research reactor and other equipment assistance programs.
3. Isotope, radiation, and research programs.
4. Training and education programs.
5. Information exchange programs, including exhibits and special conferences (other than the Geneva Conference).
6. Bilateral agreements for cooperation.
7. Euratom.
8. Geneva Conferences.
9. International Atomic Energy Agency.
10. Other international arrangements, other than NATO.
11. U.N. activities and agencies.
12. Policies and procedures to prevent diversion of fissionable materials from peaceful to military purposes.

It was further agreed that * * * any Atomic Energy Commission or Department of State suggestions for related areas not specifically requested in the above listing will be incorporated in the most appropriate category.

LETTER OF TRANSMITTAL FROM ATOMIC ENERGY COMMISSION

In one of your letters dated November 20, 1959, you requested a background paper on the "Information Exchange Programs of the United States."

I am happy to enclose for your information * * * a report on the "U.S.A.E.C. Technical Information Foreign Exchange Programs" prepared by the Commission's Division of Information Services.

U.S.A.E.C. TECHNICAL INFORMATION FOREIGN EXCHANGE PROGRAMS

I. FOREWORD

This paper deals with the scope and coverage of the Atomic Energy Commission technical information exchange programs with foreign countries and organizations, stressing the usefulness and impact of the programs and estimating the resultant tangible exchange benefits to the United States nuclear energy program.

These foreign exchange programs are valuable by-products of the Commission's domestic technical information program. The Technical Information Service was established to fill a vital need in the AEC research program which is carried out in the U. S. universities and laboratories. Scientists at each facility must know on a timely basis what is being done in the various areas of nuclear research. By providing the needed information from a central point -- the Technical Information Service -- the AEC:

1. Places information in the hands of the U. S. scientific community faster than would be possible by other means.
2. Does a more thorough job of information gathering and processing than any of the various laboratories or universities could do individually.
3. Saves money by avoiding the duplication that would result from individual effort.

This central information program lends itself readily to the foreign information exchange programs of the AEC and makes possible a worldwide system of information collection which is of benefit to nuclear science, both foreign and domestic.

II. SUMMARY

The U. S. Atomic Energy Commission is providing exceptional support to the interchange of scientific information throughout the world's scientific community. As directed by the Atomic Energy Acts of 1946 and 1954 the AEC:

(1) Records and reproduces as rapidly as possible the scientific and technological data developed in its own research and technical programs.

(2) Maintains acquisition and exchange programs with nuclear research centers throughout the world.

(3) Compiles the world's most comprehensive scientific information collection in the field of nuclear science.

(4) Bibliographically organizes, packages and distributes for the use of all peoples this body of knowledge of the atom and its application to peaceful purposes.

The prestige of the United States Government in the world's scientific community is undoubtedly enhanced by the pre-eminence accorded the Atomic Energy Commission technical information program. The documentary products of the AEC technical information program have assisted materially in establishing the basic framework of the atomic energy information program of all friendly governments; the AEC bibliographic tools and procedures are the world standards in nuclear science.

In return for AEC assistance, the nuclear centers of foreign countries are providing to the Commission, for the use of all U. S. scientists, documented results of their respective nuclear energy programs. Thus valuable reports and treatises from the outstanding scientific sources are obtained for American science through this information exchange program.

III. DISCUSSION

A. USAEC MATERIAL MADE AVAILABLE ON EXCHANGE

The ultimate product of scientific and technological research and development activities will be called knowledge. This knowledge to be most extensively useful must be recorded, organized, reproduced, announced and distributed. Such processing by the AEC of information growing from research and development work in nuclear science all over the world produces documentary materials and bibliographic tools for the use of nuclear scientists, engineers and technicians everywhere. All of these information materials are made available overseas through the AEC information exchange program and are, almost without exception, the framework upon which is built the information programs of foreign countries. Principal of these materials are Nuclear Science Abstracts, Research and Development Reports, Proceedings of Scientific Symposia and Meetings, Technical Books, Technical Progress Reviews, Bibliographies and Technical Films.

(1) Nuclear Science Abstracts

The basic reference of atomic energy literature is Nuclear Science Abstracts. This abstract journal, published twice each month by the U.S. Atomic Energy Commission, provides abstracts of the literature on nuclear science and technology and immediate and detailed indexes to that literature.

The coverage of Nuclear Science Abstracts is world-wide and includes abstracts of (a) research reports of government agencies, universities, and

54953 O—60—vol. 2——4

industrial research organizations; (b) articles appearing in technical and scientific journals; and (c) books, translations, and patents. NSA has been published since 1948, and is the only abstract journal devoted solely to nuclear science. Its expanding size and scope have paralleled the growth of nuclear enterprise throughout the world. In 1957, Nuclear Science Abstracts contained 14,000 abstracts. More than 23,000 abstracts were included in the 1959 volume of NSA, which runs about 9500 pages in length.

The growing volume of the world's scientific literature in all disciplines has created a serious problem for the user, who must allocate more and more of his time to locating and digesting the scientific data of value to him. Every effort, therefore, is made to organize Nuclear Science Abstracts so that it will be of maximum use to the reader with minimal time investment.

To facilitate the rapid review of the current literature in a field of interest to a particular user, abstracts in each issue of Nuclear Science Abstracts are grouped under broad subject categories. Of greater significance than ease of scanning, however, is an innovation in indexing patterns which

greatly facilitates both current and retrospective searching for specific data. Each semimonthly issue carries four comprehensive and detailed indexes: (a) subject, (b) personal author, (c) corporate author, and (d) report number (with source and price information). These indexes are cumulated and published as special index issues four times each year. The first quarter cumulation covers issues 1 to 6; the semiannual, 1 to 12; the third quarter, 13 to 18; and the annual, 1 to 24. A significant development in production techniques enables the AEC to prepare these comprehensive new indexes and publish them in Nuclear Science Abstracts without adding to the total time required for publication of any of the abstract journal's issues. Furthermore, the first and third quarter cumulated index issues are distributed about three weeks following the close of the quarter; the semiannual index issue late in July; and the annual index issue early in February of the ensuing year.

(2) Research and Development Reports

Reports form the major proportion of the literature of atomic energy. The ratio of professional and technical journal articles to published reports is increasing

but reports still remain a most important source of scientific and technical information of atomic energy. In a sense, they represent a new form of scientific literature that requires special forms of bibliographic control.

Reports are a more primitive form of scientific and technical literature than professional journal articles because they are produced earlier in the research program. Since the scientific community now consumes information virtually as quickly as it is produced, this information must be recorded as quickly as possible.

The bulk of the AEC technical information has been made available in the 28,000 research and development reports published by the AEC itself. Additional AEC reports, estimated at 4000, will be produced and distributed during 1960. Generally, the reports fall into two categories, progress type and summary. A progress report may cover a specific project or a large number of activities of an entire laboratory for a given period of time, and is usually issued at regular monthly, quarterly, semiannual or annual intervals. In the normal course of scientific progress the results described may be superseded. In general practice proven data are extracted from progress reports

and published in the summary reports or in the technical journal literature. The progress report is important because it is the only available written source of the material until the summary report or technical journal article is published and delays in writing and publishing summary reports or journal articles may run as high as a year or two. Moreover, progress reports are usually the only written source of negative information, that is, the record of the difficulties and failures experienced with certain experiments or techniques; and of the incidental data such as the preparations necessary for experiments and the rationale for adopting certain approaches. This information is often missing from the summary report or journal article.

Although important, the progress report is primarily a temporary reference until the summary report appears. The summary report, of course, is the most useful report and the type most frequently sought. The summary report usually is well written and is, therefore, very valuable to the scientific worker with limited time for literature study. The scientist desiring more detailed information will often supplement the topical summary report with progress reports.

(3) Proceedings of Scientific Symposia and Meetings

During the past decade, meetings, conferences, and

symposia have become important mechanisms for the exchange of information on virtually every aspect of nuclear science and technology. Papers prepared for these gatherings are a valuable technical information resource. The United States Atomic Energy Commission seeks to employ this resource for the benefit of the world's scientific community by publishing the proceedings of technical meetings. A listing and description of proceedings of meetings in which the Commission or its contractors were sponsors, co-sponsors, or major participants is shown in Attachment 1.

(4) Technical Books

Literally tens of thousands of reports are being written each year throughout the world in the various scientific disciplines involved in atomic energy work. Because the number of reports is so great and the rate of obsolescence is high, there is an essential need for comprehensive books and review journals which condense the volume of printed words into high quality "state-of-the-art" presentations. To help meet the need for such books the USAEC undertook in 1955 an intensive program to encourage publication and, where necessary, to sponsor preparation of book manuscripts. Through government financial support and special contractual

arrangements, USAEC sponsored books have been made widely available at moderate prices.

During 1958 and 1959 the AEC published 20 books and initiated the writing of 16 others. Twelve new AEC-sponsored volumes were presented to key delegates of the Second International Conference on the Peaceful Uses of Atomic Energy at Geneva in September 1958. A complete description of all USAEC books has been published in the USAEC book catalog entitled "Technical Books," (Attachment 2.)

(5) Technical Progress Reviews

Because published books in certain rapidly developing fields cannot be kept sufficiently current to meet the needs of science and industry, the USAEC prepares and issues Quarterly Technical Progress Reviews covering specific subject areas. These journals describe, analyze, and evaluate the latest developments in these fields. Not only is the published literature covered in these Reviews but the editors, because of their intimate association with the existing research programs, often include information on the latest developments in advance of publication of the information in formal full-length articles or reports. The Reviews are an efficient current reference in rapidly developing research areas,

provide convenient summaries and are fully referenced to the basic research reports. Three quarterly Reviews, now in their second year of publication, are entitled Power Reactor Technology, Reactor Core Materials, and Reactor Fuel Processing. A fourth, entitled, Nuclear Safety, was initiated in September 1959.

(6) Bibliographies

Another important mechanism to facilitate the identification, selection and location of literature within specific subject areas is the bibliography. The preparation of bibliographies for retrospective scientific searching has always been an important part of AEC technical information activity. These compilations range from short title lists to comprehensive, annotated bibliographies that are in themselves indexed and subject categorized.

(7) Technical Films

The technical film is becoming of increasing importance in technical information dissemination and as scientific training tools. The USAEC has produced 71 professional level technical motion picture films. Forty-five of these were shown in four languages -- Spanish, English, French and Russian -- at the Second International Conference on the Peaceful Uses of Atomic Energy at Geneva in September 1958. The films cover a

wide variety of topics from power reactors to uses of isotopes and radiation in industry, agriculture, medicine and research. They are in color and range in length from 5 to 55 minutes.

Prints of these films with foreign language sound tracks are available on loan from USAEC Scientific Representatives overseas or from U.S. Information Service offices. A complete set of the films in English have been presented to the IAEA. In addition, films produced subsequent to the 1958 Geneva Conference have been given the IAEA and are in the Commission's foreign offices.

B. INFORMATION EXCHANGES

Nuclear science information flows from the United States to other countries either (1) under arrangements covering cooperation between this country and other countries or international organizations; or (2) under arrangements more limited in scope and covering individual document exchanges between the AEC and overseas research organizations, industrial organizations, learned societies, universities, academies and institutes.

The largest foreign contributors of reports and other informational materials to the U.S. are naturally those countries with older active atomic energy programs. During calendar 1959, for example, Australia, Belgium, Canada, Great Britain, Switzerland, and the Netherlands contributed over 74% of the 1,976 topical reports, translations, and reprints received from foreign sources and processed by the AEC for the U.S. scientific community.

The AEC is constantly refining and expanding its information exchange program to effect acquisition at the earliest possible date of the documented results of any non-U.S. atomic energy research. U.S. participation in the International Conference on the Utilization of Atomic Energy Scientific and Technical Information, May 26-29, 1958, in Geneva, Switzerland and the subsequent visits of information officers from the International Atomic Energy Agency, the United Kingdom, Euratom and other European organizations to this country have done much to promote the prompt receipt of European informational materials by the AEC for use and inclusion in the various U.S. programs.

(1) Exchange Programs-Comprehensive Collection of Reports

a. Depository Collections

As part of the international program concerning the peaceful uses of atomic energy, the United States has presented 83 depository library collections to 58 nations and 5 international organizations. These include 64 depositories presented officially to foreign governments and international organizations under the President's Atoms-for-Peace program and 19 depositories provided foreign governments, institutions, and laboratories under closely controlled exchange agreements. The collections are complete depositories of AEC unclassified publications and contain:

(1) 28,000 research and development reports (approximately 6,000 full size, 22,000 microcard)

(ii) A complete set of Nuclear Science Abstracts (13 volumes)

(iii) 75 books and handbooks

(iv) 300 bibliographies

(v) The 4 AEC Quarterly Journals in reactor technology

(vi) A microcard reader

An estimated 4,000 additional AEC reports will be added to each collection during 1960 in the continuing action to keep them current.

In 1950, coinciding with the establishment of public domestic depositories in the United States, the AEC presented report collections to Great Britain and Canada under the terms of existing bilateral exchange agreements.

In 1954, following President Eisenhower's announcement of the U.S. Atoms-for-Peace Program, Ambassador Henry Cabot Lodge, Jr., notified the Ninth General Assembly of the United Nations that the United States was prepared to give each nation requesting it, a complete collection of AEC unclassified documents and complete files of abstract journals, bibliographies and other library tools. Requests from various foreign offices to the U.S. Department of State for the libraries and associated tools began almost immediately. A list of the 83 current depositories is presented at the end of this paper (Attachment 3).

A complete AEC depository collection was dispatched to the IAEA on December 30, 1957. The AEC materials make up the major portion of the IAEA library collection and the AEC bibliographic tools have been adopted by the Agency as its official key to non-AEC technical information as well as to the AEC materials in the Agency files. Close and continuous liaison is maintained between the AEC and IAEA technical information officers to assure maximum integration of the information programs of both organizations and to preclude duplication and wasted effort. The AEC Assistant Director for Technical Information Service serves on the IAEA Advisory Panel on Scientific Information.

On November 24, 1959, Professor V. S. Emelyanov, Head of the U.S.S.R. Main Administration for Utilization of Atomic Energy, and Chairman McCone signed a Memorandum providing for unclassified exchanges in the field of peaceful uses of atomic energy. The parties agreed to the exchange of unclassified abstracts, reports and documents on a reciprocal basis. Included will be abstracts of formal reports published in the technical literature as well as informal and progress reports

which are normally only circulated within the atomic energy programs of the two countries.

b. Materials Received Under Exchanges

In each of the exchanges the U.S. has requested that all the atomic energy reports of each organization receiving a U.S. depository collection be reciprocally supplied to this country. Each country receiving the AEC report collection is required to submit a written statement agreeing to provide the U.S. with similar unclassified information originating in that country. All foreign reports received are promptly abstracted, indexed, and announced in Nuclear Science Abstracts and are made available to the U.S. scientific community.

There is no item-for-item relationship between the collections presented to foreign nations and the amount of informational materials returned to this country. Many countries are only beginning their nuclear programs and reports should increase in number as well as value during the next few years.

Following is a condensed description of the principal returns under the program:

-- The U.K. forwards multiple copies of its topical reports to the AEC. Normally, 165 copies of a report to be made publicly available are received. The AEC

distributes copies of these reports to domestic depository libraries to make them available for the use of the U.S. scientific public. British reports scheduled for publication in one of the scientific journals of that country are normally forwarded to the AEC in sufficient multiple copies to make a distribution as preprints to interested AEC program divisions and AEC contractors. United Kingdom translations of foreign literature are also received -- so that at the discretion of the AEC, these too can be announced in NSA and made available as required.

-- Canada makes direct distribution of many of its reports to AEC depository libraries in the United States. Canada also provides the AEC with 50 additional copies of its unclassified reports.

-- France, the second largest contributor of reports, translations, reprint materials, and journals, also provides copies of its informational materials in bulk to the AEC for special distribution. Soviet, Japanese, and German works translated into French are also furnished to the AEC.

-- Australia, Belgium, Switzerland and the Netherlands provide topical reports, translations, reprints and preprints.

(2) Exchange Program - Individual Publications

a. Exchanges

The Atomic Energy Commission publications exchange program was initiated in 1949. The following organizations were asked to recommend overseas research laboratories, universities, learned societies, institutes, and academies which might be interested in establishing active productive exchanges with the USAEC:

Division of Cultural Cooperation,
Pan American Union

Committee on Inter-American Scientific Publications,
American Academy of Arts and Sciences

Civil Affairs Division
Special Staff,
Department of the Army

International Relations Office,
American Library Association

United States Book Exchange,
Library of Congress

American Swiss Foundation for
Scientific Exchange

The first exchange proposals were dated October 4, 1949 and were transmitted by the Department of State to the American Embassies in the appropriate countries. In the first round, 120 exchanges were established in 18 foreign countries. Early exchange proposals by the AEC offered Nuclear Science Abstracts and selected

current reports. A sample issue of NSA and a document list accompanied all proposals. During the past 10 years the publications exchange program has been expanded and at present there are 431 addressees in 43 countries (Attachment 4).

The AEC carefully monitors each exchange to ensure receipt of valuable documentary informational materials. Non-productive exchanges are weeded out and replaced. The material provided to the AEC consists largely of scientific reports, technical and professional journals, special monographs and theses. Through the channel of the AEC publications exchange program most of the valuable scientific reports of foreign non-governmental research laboratories reach the AEC scientific family.

The number of organizations located in Eastern European countries with which the AEC has document exchange arrangements has increased in the past 3 years to 36 exchanges as follows:

Czechoslovakia	6	organizations
Hungary	4	"
Poland	4	"
Rumania	4	"
USSR	14	"
Yugoslavia	4	"

Prior to the inauguration of these exchanges Soviet bloc material was virtually unavailable to the USAEC.

The cost to the USAEC, except for handling and mailing, is the printing costs for the relatively small number of copies needed since all AEC material exchanged is initially reproduced for the U.S. program.

b. Materials Received Under Exchanges

In addition to reports, monographs, theses, annual reports, and other miscellaneous types of scientific publications, approximately 350 journal titles and other serial publications are received on a regular basis. The total number of items abstracted for Nuclear Science Abstracts from exchange journals was approximately 8,000 for calendar year 1959. The bulk of exchange material (other than report materials) is forwarded to the Oak Ridge Institute of Nuclear Studies Library which makes these materials available on interlibrary loan throughout the United States.

The subjects of the reports and preprints received on exchange from other countries are generally nuclear particle reactions, shielding, radiation effects, chemistry and metallurgy of interest to nuclear scientists, criticality calculations, general reactor safety problems, tracer chemistry, thermonuclear and thermoelectric effects. This report material is made

available to the U. S. scientific community through the AEC depository libraries.

(3) 1959 Statistical Data for Materials Received under All Information Exchange Programs

A tabulation of report materials, translations, and preprints received by the AEC during 1959 and announced in NSA follows (Countries are listed in the order of the number of titles selected for NSA):

Number of Titles	Country
982	England
255	France
136	Canada
89	U.S.S.R.
86	Poland
63	Belgium
59	Spain
54	Germany
45	Australia
37	Italy
28	Japan
27	Sweden
27	Switzerland
27	Norway
19	Brazil
13	Denmark
11	Israel
5	Argentina
4	New Zealand
3	Hungary
3	Portugal
1	Austria
1	Ecuador
1	Czechoslovakia
1,976	

(4) Foreign Accession Lists

Another valuable source of foreign atomic energy literature is the accession lists forwarded to the AEC by many countries. Although many of these lists include informational materials forwarded to these countries by the AEC, they also list reports which are not distributed automatically to us by the originating country. Reports listed in accession lists are obtained for the AEC by direct request from the report originator, the country which announced the report in its holdings, or the IAEA.

C. INFORMATION WORKSHOPS OVERSEAS

The first international regional conference and workshop sponsored by the USAEC and the U. S. Department of State on the utilization of atomic energy information was held on May 26-29, 1958 in Geneva, Switzerland. The conference was concerned with the recording, abstracting, indexing, control, exchange and general dissemination of the scientific and technical literature of atomic energy. In attendance were the atomic energy technical information officers from Austria, Belgium, Denmark, France, Germany, Israel, Italy, Netherlands, Norway, Spain, Sweden, Switzerland, United Kingdom and the United States as well as spokesmen for the European Organization for Nuclear Research (CERN), European Coal and Steel Authority (ECSC), Euratom, International Atomic Energy Agency (IAEA), and the Organization Europeenne de Cooperation Economique (OEEC).

The conference was essentially a workshop in which topics and problems

were discussed and information tools and products were demonstrated and explained as each representative described in detail the technical information program of his organization and presented his ideas on improving present practices and procedures.

The conference participants unanimously adopted the USAEC technical information standards, tools, and products as the basis of their respectiv programs. The major actions by the conference were:

(1) Unanimous recognition of Nuclear Science Abstracts as the authoritative announcement and cataloging medium for the field of nuclear science.

(2) Resolution to provide automatically to the USAEC all source materials in their holdings within the scope of NSA but not yet included in the journal.

(3) Resolution to airmail to the USAEC new reports immediately upon issuance to ensure the earliest announcement and availability to the scientific community.

(4) Resolution to adopt English as the international language in nuclear science and if possible to issue technical and scientific reports in the English language.

(5) Resolution to attempt to maximize the effectiveness of their translation efforts by providing to the USAEC information on translations planned, in progress and completed. These data are included in the USAEC Translation List for the use of all countries.

(6) Resolution to translate scientific and technical reports into English for maximum utility to the overall scientific community.

(7) Resolution to attempt to pool bibliography capacities by providing to the USAEC information on their bibliographies planned, in progress and completed for inclusion in a special USAEC bibliography bulletin available to all.

Similar workshops are being programmed for the Latin American countries and for the countries of the Far East.

D. AEC TECHNICAL INFORMATION EXHIBITS OVERSEAS

Through AEC international exhibits, the peoples of the world are acquiring a greater understanding of the United States' efforts in the peaceful applications of atomic energy. The AEC has featured a Technical Information Center in four such exhibits -- the First and Second United Nations International Conferences on the Peaceful Uses of Atomic Energy, Geneva, Switzerland; Tokyo International Trade Fair; and the World Agriculture Fair, New Delhi, India.

Following is a brief description of each of these information exhibits:

(1) First United Nations International Conference on the Peaceful Uses of Atomic Energy, Geneva, Switzerland, August 8-20, 1955

At its Technical Library Exhibit the AEC displayed a collection of books, journals, and reports that represented at that time, the total United States contribution to the unclassified scientific literature on atomic energy. The collection contained over 12,000 reports in full-size and

microcard forms, 150 books, and 62 different scientific journals. The collection also contained a card index so that it could be used as a working reference library for delegates attending the Conference. After serving successfully in this capacity during the Conference, the collection was presented formally to the United Nations for retention at Geneva, as an Atoms-for-Peace depository library.

In addition, the United States presented an 8-volume set of Selected Reference Material, together with an Introductory Volume, (printed in four languages, and illustrated with color photographs) to the Official Representatives of the 73 nations and eight specialized United Nation's agencies taking part in the Conference. These volumes supplemented material presented in technical and scientific papers and provided more detailed information on many aspects of the peaceful uses of atomic energy.

(2) Second United Nations International Conference on the Peaceful Uses of Atomic Energy, Geneva, Switzerland, September 1-13, 1958

More than 25 tons of AEC publications were taken to Geneva for the delegates and observers from 67 nations. The Technical Information Center maintained a collection of 250 scientific, technical, and trade journals in the many fields in which atomic energy is applicable. United States publishers contributed more than 400 books on all phases of atomic energy. The Center also contained a selection of United States government reports and documents on various aspects of nuclear science, and a card

catalog of all unclassified reports of the Commission. A complete collection of AEC scientific and technical publications in microcard form and some 11,500 engineering drawings on microfilm were available for inspection on illuminated viewers. A catalog listing all the books and journals on display at the Center, and a brochure, printed in four languages, provided availability information.

A feature display exhibited the specially prepared set of 13 technical books presented by the United States to principal representatives of the other nations, and the U. S. pictorial book, Atoms for Peace, USA, 1958, which was distributed at the Center.

(3) Tokyo International Trade Fair, May 5-22, 1959

Unlike the exhibition at Geneva, the nature of the total Tokyo exhibit and limitations on funds, staffing, and space required a special approach for the Technical Information Center. A detailed exposition of technical information products and services was conveyed to a selected group of prominent Japanese scientific leaders by a single expert using a number of skillfully designed and executed visual aids.

The Center displayed copies of books, manuals and reports on Commission sponsored research and development work. Approximately 500 Japanese science leaders visited the Center. The Center also was a clearing house for questions about United States nuclear energy technology.

(4) World Agriculture Fair, New Delhi, India - December 11-February 14, 1960

This Technical Information Center featured the Commission's most recent publications in the life sciences. More than 300 books, manuals, reports, and scientific papers on Commission-sponsored research and development in agriculture, biology and medicine, research reactors, radiation facilities and radioisotopes were displayed. As at the Tokyo International Trade Fair, a United States technical information specialist explained the information available from the United States sources and how it could be obtained. Five hundred Indian scientists, engineers, industrialists and government personnel were invited to visit the Technical Information Center for individual discussions on the current scope and availability of United States atomic energy information.

In view of the success of the Technical Information Centers in Geneva, Tokyo, and New Delhi, the AEC plans Information Centers in six international exhibits in 1960 and 1961 as follows: Cairo, Argentina, and Karachi, in 1960; Brazil, Peru and Venezuela in 1961.

E. EVALUATION

As required by the Atomic Energy Act of 1946 and its revision of 1954, the USAEC science information exchange program is giving fullest possible support to the Commission's mission of "supporting to the utmost the interchange of scientific information throughout the world's scientific community." The AEC's technical information program is the world's standard in the nuclear science field and is the framework upon which has been or

is being built the atomic energy technical information programs of all countries of the free world. The very large measures of good will and prestige resulting from this activity is especially valuable at this time of international scientific competition.

Of equal importance, through this program the United States receives thousands of valuable scientific documents of immediate use to the Nation's scientific programs. Specific values accruing to this country derive from the fact that the program aids in eliminating from the laboratory research of U. S. scientists unnecessary and duplicatory efforts and thus accelerates existing U. S. scientific programs and releases valuable scientific manpower to explore new challenging areas. This saving of critical calendar time for the U. S. in the competition for world scientific leadership is of inestimable value.

Through the AEC information exchange program the overall fund of scientific knowledge available to all scientists has been greatly increased. The AEC has set the pace among free peoples in the dissemination of scientific knowledge and the AEC distribution procedures and patterns are being adopted by all major nations in the free world for use in disseminating their own technical data. This world wide dissemination of the scientific knowledge of the peaceful uses of the atom fosters the cross fertilization of ideas necessary for scientific advancement.

Skills and techniques in scientific documentation in other countries are not as advanced as those developed by the AEC for the bibliographic organization and control of the tremendous volume of recorded nuclear science data. However, the AEC is programming specialized technical information workshops to help nations and international organizations with U. S.

Atoms-for-Peace collections to derive the maximum value from this resource. The first such workshop was held in Geneva in May 1958 with the main objective of maximizing the utility of the Atoms-for-Peace collections but also to ensure automatic provision to the United States of valuable documentary scientific materials previously either unavailable or available only after lengthy delays and complex procurement actions costly in terms of time, manpower and money.

ATTACHMENT ONE

SUBJECT EXCERPTS FROM

PROCEEDINGS OF TECHNICAL MEETINGS

AEC PAMPHLET

ACCELERATORS

NOTES ON THE HIGH-ENERGY ACCELERATOR CONFERENCE [ON] DECEMBER 16–17, 1952
(BNL-213)

By M. Hildred Blewett, Brookhaven National Lab., Upton, N. Y., January 1953. 32p. $6.30(ph OTS); $3.00(mf OTS).

CONFERENCE ON SHIELDING OF HIGH-ENERGY ACCELERATORS Held at New York, April 11 to 13, 1957
(TID-7545)

Division of Research, AEC, and New York Operations Office, Health and Safety Lab., AEC. Dec. 6, 1957. $2.75(OTS).

BIOLOGY AND MEDICINE

PROCEEDINGS OF THE CONFERENCE ON RADIOIODINE Sponsored by the Argonne Cancer Research Hospital, United States Atomic Energy Commission, and the Clinics of the University of Chicago, November 5 and 6, 1956, Chicago, Illinois
(ACRH-100)

Edited by Dwight E. Clark, Argonne Cancer Research Hospital, Chicago. 218p. $3.00 (OTS).

SECOND CONFERENCE ON RADIATION CATARACTS AND NEUTRON EFFECTS for the United States Atomic Energy Commission. Abstracts of Papers
(AECU-3016)*

National Research Council, Div. of Medical Sciences, Dec. 8, 1950. 34p.

THIRD CONFERENCE ON RADIATION CATARACTS for the United States Atomic Energy Commission. Abstracts and Proceedings
(AECU-3017)*

National Research Council, Div. of Medical Sciences, Jan. 28, 1952. 73p.

FOURTH CONFERENCE ON RADIATION CATARACTS for the United States Atomic Energy Commission. Abstracts and Proceedings
(AECU-3019)*

National Research Council, Div. of Medical Sciences, Feb. 28, 1953. 93p.

FIFTH CONFERENCE ON RADIATION CATARACTS for the United States Atomic Energy Commission. Abstracts and Proceedings
(AECU-3018)*

National Research Council, Div. of Medical Sciences, Mar. 26, 1954. 116p.

THERAPY OF RADIOELEMENT POISONING. Transcription of a Meeting on Experimental and Clinical Approaches to the Treatment of Poisoning by Radioactive Substances, Held October 20 and 21, 1955
(ANL-5584)

Edited by Marcia White Rosenthal, Argonne National Lab., Lemont, Ill., August 1956. 181p. $1.00(OTS).

THE MAJOR METABOLIC FUELS: Brookhaven Symposia in Biology No. 5
(BNL-206)

Brookhaven National Lab., Upton, N. Y., September 1952. 241p. $5.50(OTS).

THE THYROID. Report of Symposium Held June 9 to 11, 1954. Brookhaven Symposia in Biology No. 7
(BNL-305)

Brookhaven National Lab., Upton, N. Y. 278p. $1.75(OTS).

MUTATION. Report of Symposium Held June 15 to 17, 1955. Brookhaven Symposia in Biology No. 8
(BNL-350)

Brookhaven National Lab., Upton, N. Y. 240p. $1.25(OTS).

GENETICS IN PLANT BREEDING. Report of Symposium Held May 21 to 23, 1956. Brookhaven Symposia in Biology No. 9
(BNL-396)

Brookhaven National Lab., Upton, N. Y. 243p. $1.25(OTS).

HOMEOSTATIC MECHANISMS. Report of Symposium Held June 12 to 14, 1957. Brookhaven Symposia in Biology No. 10
(BNL-474)

Brookhaven National Lab., Upton, N. Y. 276p. $3.00(OTS).

*Copies are available from Division of Medical Sciences, National Research Council, 2101 Constitution Ave., Washington 25, D. C.

RARE EARTHS IN BIOCHEMICAL AND MEDICAL RESEARCH: A Conference Sponsored by the Medical Division, Oak Ridge Institute of Nuclear Studies, October 1955
(ORINS-12)

Edited by Granvil C. Kyker and Elizabeth B. Anderson, Oak Ridge Inst. of Nuclear Studies, Inc., Tenn. 476p. $2.20(OTS).

MEDICAL DIVISION QUARTERLY PROGRESS REPORT FOR JANUARY 1–MARCH 31, 1954. TELETHERAPY DESIGN PROBLEMS III (Consists in part of the PROCEEDINGS OF THE THIRD INDUSTRIAL CONFERENCE ON TELETHERAPY
(ORO-127)

Oak Ridge Inst. of Nuclear Studies, Inc., Tenn. 105p. $14.00(ph OTS); $4.75(mf OTS).

A CONFERENCE ON THE USE OF ISOTOPES IN PLANT AND ANIMAL RESEARCH Held on June 12, 13, and 14, 1952
(TID-5098)

Kansas State Coll., Argonne National Lab., and Isotopes Div., AEC, April 1953. 276p. $1.25(GPO).

THE ROLE OF ATOMIC ENERGY IN AGRICULTURAL RESEARCH. Proceedings of the Fourth Annual Oak Ridge Summer Symposium, August 25–30, 1952
(TID-5115)

Compiled by C. L. Comar and S. L. Hood, Oak Ridge National Lab., Tenn., and Oak Ridge Inst. of Nuclear Studies, Inc., Tenn., January 1953. 492p. $2.25(OTS).

A CONFERENCE ON RADIOACTIVE ISOTOPES IN AGRICULTURE Held on January 12, 13, and 14, 1956, at Michigan State University, East Lansing, Michigan
(TID-7512)

Argonne National Lab. Council of Participating Institutions, Lemont, Ill., January 1956. 420p. $3.00(GPO).

ROENTGENS, RADS, AND RIDDLES. A Symposium on Supervoltage Radiation Therapy

Edited by Milton Friedman, Marshall Brucer, and Elizabeth Anderson, Oak Ridge Institute of Nuclear Studies, Inc., Tenn., 1959. 495p. $3.50(GPO).

THE SHORTER-TERM BIOLOGICAL HAZARDS OF A FALLOUT FIELD. Symposium Held December 12-14, 1956

Edited by Gordon M. Dunning, Division of Biology and Medicine, AEC, and John A. Hilcken, Armed Forces Special Weapons Project, Department of Defense, 1958. 236p. $1.75(GPO).

CHEMISTRY

MINUTES OF THE MEETING ON THE ANALYSIS AND METALLOGRAPHY OF HYDROGEN IN URANIUM, Held June 22, 1955
(BMI-X-128)

Edited by M. W. Mallett and C. B. Griffith, Battelle Memorial Inst., Columbus, Ohio, Sept. 15, 1955. Declassified Feb. 14, 1957. 76p. $0.55(OTS).

CONFERENCE ON PLUTONIUM CHEMISTRY IN THE PUREX PROCESS AT ORNL
(CF-50-2-112)

By F. R. Bruce, Oak Ridge National Lab., Tenn., Jan. 18, 1950. Declassified Mar. 13, 1957. 14p. $3.30(ph OTS), $2.40(mf OTS).

BELGIAN SYMPOSIUM ON CHEMICAL PROCESSING, I SESSION: ENGINEERING OF RADIOCHEMICAL PLANTS CONTACTORS AND AUXILIARIES
(KAPL-1808)

By J. K. Davidson, Knolls Atomic Power Lab., Schenectady, N. Y., June 27, 1957. 49p. $0.35(OTS).

PROCEEDINGS OF BIO-ASSAY AND ANALYTICAL CHEMISTRY MEETING, October 6 and 7, 1955
(NLCO-595)

Edited by Reynold L. Hoover, National Lead Co. of Ohio, Cincinnati, Oct. 7, 1955. 156p. $0.75(OTS).

BERYLLIUM AND BERYLLIUM OXIDE PRODUCTION AND DEVELOPMENT
[NYO-110(Del.)]

New York Operations Office, Special Materials Div., AEC, Nov. 21, 1949. Changed from Official Use Only with deletions Feb. 9, 1956. 215p. $33.30(ph), $9.60(mf) OTS.

RAW MATERIALS CONFERENCE ON SOLVENT EXTRACTION, Held at Winchester, Massachusetts, January 17–18, 1955
(TID-7508)

Compiled by Arthur M. Ross, National Lead Co., Inc., Raw Materials Development Lab., Winchester, Mass., Apr. 1, 1955. Declassified Dec. 15, 1955. 72p. $0.40(OTS).

INDUSTRIAL TECHNICAL INFORMATION MEETING ON COLD PROCESSING OF ENRICHED URANIUM, Oak Ridge, September 13–15, 1956
[TID-7518(Pt. 1)]

Oak Ridge Operations Office, AEC. 99p. $0.50(OTS).

PROCESSING OF URANIUM–MAGNESIUM FLUORIDE SLAG—Technical Information Meeting, December 6, 1956
[TID-7528(Pt. 1)]

Oak Ridge Operations Office, Feed Materials Div., AEC, December 1956. 83p. $0.50(OTS).

CERAMIC INFORMATION MEETING Held at Oak Ridge National Laboratory on October 1, 2, and 3, 1956
[TID-7530(Pt. 1)]

Oak Ridge National Lab., Tenn., April 1957. 165p. $1.00(OTS).

SYMPOSIUM ON THE REPROCESSING OF IRRADIATED FUELS Held at Brussels, Belgium, May 20–25, 1957
(TID-7534)

Atomic Energy Commission, Washington, D. C. (Issued in three books: Bk. 1, 481p.; Bk. 2, 331p.; and Bk. 3, 364p.) $10.50(OTS).

FIRST CONFERENCE—ANALYTICAL CHEMISTRY IN NUCLEAR REACTOR TECHNOLOGY, November 4–6, 1957, Gatlinburg, Tennessee
(TID-7555)

Edited by C. D. Susano, H. S. House, and Margaret A. Marler, Oak Ridge National Lab., Tenn., June 1958. 261p. $3.50(OTS).

ANALYTICAL CHEMISTRY IN NUCLEAR REACTOR TECHNOLOGY. PART 1. SPECIFIC APPLICATIONS OF DIVERSE METHODS OF CHEMICAL ANALYSIS. Second Conference, Gatlinburg, Tennessee, September 29 through October 1, 1958
[TID-7568(Pt.1)]

Edited by C. D. Susano, H. P. House, and Margaret A. Marler, Oak Ridge National Lab., Tenn., April 1959. 289p. $3.00(OTS).

ANALYTICAL CHEMISTRY IN NUCLEAR REACTOR TECHNOLOGY. PART 2. INSTRUMENTATION, REMOTE CONTROL TECHNIQUES, AND NUCLEONICS. Second Conference, Gatlinburg, Tennessee, September 29 through October 1, 1958
[TID-7568(Pt. 2)]

Edited by C. D. Susano, H. P. House, and Margaret A. Marler, Oak Ridge National Lab., Tenn., April 1959. 236p. $2.50(OTS).

ANALYTICAL CHEMISTRY IN NUCLEAR REACTOR TECHNOLOGY. PART 3. PARTICLE-SIZE ANALYSIS. Second Conference, Gatlinburg, Tennessee, September 29 through October 1, 1958
[TID-7568(Pt. 3)]

Edited by C. D. Susano, H. P. House, and Margaret A. Marler, Oak Ridge National Lab., Tenn., April 1959. 101p. $1.00(OTS).

PROCEEDINGS OF THE SECOND ANNUAL MEETING ON BIO-ASSAY AND ANALYTICAL CHEMISTRY, October 11 and 12, 1956
(WASH-736)

Los Alamos Scientific Lab., N. Mex., Sept. 27, 1957. 163p. $4.25(OTS).

COMPUTERS

PROCEEDINGS OF A SYMPOSIUM ON LARGE SCALE DIGITAL COMPUTING MACHINERY, August 3–5, 1953
(ANL-5181)

Argonne National Lab., Lemont, Ill., November 1953. 317p. $48.60(ph OTS); $11.10 [mf OTS).

CONTROLLED THERMONUCLEAR REACTIONS

CONFERENCE ON CONTROLLED THERMONUCLEAR REACTIONS, Held at Princeton University, October 17–20, 1955
(TID-7503)

Compiled by A. S. Bishop, Controlled Thermonuclear Branch, Division of Research, Atomic Energy Commission, Washington, D. C., February 1956. Declassified Mar. 17, 1959. 531p. $7.00(OTS).

CONFERENCE ON CONTROLLED THERMONUCLEAR REACTIONS, June 4–7, 1956, Gatlinburg, Tennessee
[TID-7520(Pts. 1 and 2)]

Controlled Thermonuclear Branch, Division of Research, Atomic Energy Commission, Washington, D. C., September 1956. Declassified Mar. 13, 1959. 645p. $112.70(ph OTS); $11.10(mf OTS).

CONTROLLED THERMONUCLEAR REACTIONS. A Conference Held at Berkeley, California, February 20–23, 1957
[TID-7536(Pt. 1)]

Division of Research, Controlled Thermonuclear Branch, AEC, September 1957. 44p. $1.25(OTS).

CONTROLLED THERMONUCLEAR REACTIONS, A Conference Held at Berkeley, California, February 20–23, 1957
[TID-7536(Pt. 2)]

Controlled Thermonuclear Branch, Division of Research, Atomic Energy Commission, Washington, D. C., September 1957. Declassified Feb. 20, 1959. 553p. $91.80(ph OTS); $11.10(mf OTS).

PAPERS PRESENTED AT THE CONTROLLED THERMONUCLEAR CONFERENCE Held at the Naval Research Laboratory, Washington, D. C., February 3–5, 1958
(TID-7558)

Division of Research, Controlled Thermonuclear Branch, AEC. 534p. $4.75(OTS).

PROCEEDINGS OF A CONFERENCE ON THE THEORETICAL ASPECTS OF CONTROLLED FUSION RESEARCH. Gatlinburg, Tennessee, April 27-28, 1959
(TID-7582; ORNL-2805)

Oak Ridge National Laboratory, Tenn. October, 1959. $3.00(OTS).

CONFERENCE ON THERMONUCLEAR REACTORS Held at Denver on June 28, 1952
(WASH-115)

Atomic Energy Commission, Washington, D. C., December 1952. Declassified Jan. 23, 1958. 126p. $19.80(ph OTS); $6.30(mf OTS).

CONFERENCE ON THERMONUCLEAR REACTIONS, Radiation Laboratory, University of California, Berkeley, California, April 7, 1953
(WASH-146)

Division of Research, Atomic Energy Commission, Washington, D. C., November 1953. Declassified Mar. 13, 1959. 119p. $2.50 (OTS).

CONFERENCE ON THERMONUCLEAR REACTIONS, Princeton University, October 26 and 27, 1954
(WASH-184)

Division of Research, Atomic Energy Commission, Washington, D. C., January 1955. Declassified Jan. 23, 1959. 153p. $22.80 (ph), $7.20(mf) OTS.

CONFERENCE ON THERMONUCLEAR REACTIONS, University of California Radiation Laboratory, Livermore, California, February 7, 8, and 9, 1955
(WASH-289)

Nuclear Materials Management, Division of Research, Atomic Energy Commission, Washington, D. C., June 1955. Declassified Mar. 13, 1959. 367p. $5.00(OTS).

EDUCATION

PROCEEDINGS OF THE CONFERENCE ON ENGINEERING EDUCATION AND NUCLEAR ENERGY Held at Gatlinburg, Tennessee, September 5–8, 1956
(TID-7527)

Edited by W. W. Grigorieff, Oak Ridge Inst. of Nuclear Studies, Inc., Tenn. 206p. $1.00 (OTS)

FISSION PRODUCTS

CONFERENCE ON FISSION PRODUCT UTILIZATION [Held on] February 18–19, 1952
(BNL-171)

Brookhaven National Lab., Upton, N. Y. 49p. $0.25(OTS).

GENERAL

PROCEEDINGS OF THE INTER-AMERICAN SYMPOSIUM ON THE PEACEFUL APPLICATION OF NUCLEAR ENERGY, Brookhaven National Laboratory, May 13–17, 1957
(TID-7554)

Brookhaven National Lab., Upton, N. Y. (Issued in two books: Bk. 1, 363p., and Bk 2, 250p.) $6.00(OTS).

FIFTH INTERNATIONAL CONGRESS AND EXHIBITION OF ELECTRONICS AND ATOMIC ENERGY, Rome, Italy, June 16–30, 1958 (U. S. Papers)
(TID-7557)

Atomic Energy Commission, Washington, D. C. 141p. $1.50(OTS).

US/UK GRAPHITE CONFERENCE Held at St. Giles Court, London, December 16–18, 1957
[TID-7565(Pt. 1)]

Edited by I. F. Zartman and G. B. Greenough, Division of Reactor Development, AEC, and United Kingdom Atomic Energy Authority, Industrial Group, Windscale Works, Sellafield, Cumb., England, Mar. 16, 1959. 160p. $1.75(OTS).

HEAT TRANSFER

REACTOR HEAT TRANSFER INFORMATION MEETING Held at Brookhaven National Laboratory, October 18–19, 1954
(BNL-2446)

Division of Engineering, AEC, and Brookhaven National Lab., Upton, N. Y., December 1955. 195p. $1.00(OTS).

HEAT TRANSFER. Reports from Session XII, General Information Meeting, October 24, 25, 26, 1949, Oak Ridge, Tennessee
[TID-278(Del.)]

Technical Information Service, AEC. Declassified with deletions Feb. 28, 1957. 53p. $9.30(ph OTS); $3.60(mf OTS).

REACTOR HEAT TRANSFER CONFERENCE OF 1956. Collected Papers and Reports of a

Conference Held at New York, November 1 and 2, 1956.
[TID-7529(Pt. 1)]

Compiled by John E. Viscardi, Nuclear Development Corp. of America, White Plains, N. Y., November 1957. (Issued in two books: Bk. 1, 323p., and Bk. 2, 318p.) $7.75(OTS).

HOT LABORATORY PRACTICE

HOT LABORATORIES AND EQUIPMENT. Papers Presented at Atomic Energy Commission Division of Reactor Development Information Meeting May 16, 17, and 18, 1951
[ANL-4670(Del.)]

Argonne National Lab., Lemont, Ill. 317p. $50.40(ph OTS); $11.80(mf OTS).

THE THIRD INFORMATION MEETING ON HOT LABORATORIES, May 26–28, 1954
[BNL-302(Del.)]

Brookhaven National Lab., Upton, N. Y. Declassified with deletions Feb. 18, 1957. 79p. $12.30(ph OTS); $4.50(mf OTS).

FOURTH ANNUAL SYMPOSIUM ON HOT LABORATORIES AND EQUIPMENT, Held in Washington, D. C., September 29 and 30, 1955
(TID-5280 and Suppl. 1)

September 1955. 389p. $1.75(OTS).

Suppl. 1. January 1956. 123p. $0.60(OTS).

SIXTH HOT LABORATORIES AND EQUIPMENT CONFERENCE, March 19-21, 1958, International Amphitheatre, Chicago, Illinois
(TID-7556)

Compiled by Frank Ring, Jr., Oak Ridge National Lab., Tenn., April 1959. 171p. $1.75(OTS).

INDUSTRIAL HYGIENE

FOURTH ATOMIC ENERGY COMMISSION AIR CLEANING CONFERENCE Held at Argonne National Laboratory, November 1955
[TID-7513(Pts. 1 and 2)]

Part 1: Division of Reactor Development, AEC. 320p. $1.50(OTS).

Part 2: Divison of Reactor Development, AEC. Declassified Mar. 4, 1957. 31p. $0.35(OTS).

SANITARY ENGINEERING ASPECTS OF THE ATOMIC ENERGY INDUSTRY. A Seminar Sponsored by the AEC and the Public Health Service, Held at the Robert A. Taft Engineering Center, Cincinnati, Ohio, December 6–9, 1955
{TID-7517[Pts. I and II(Del.)]}

Part I: Division of Reactor Development, AEC, and Public Health Service, Washington, D. C. 635p. (Issued in two parts: Pt. Ia, 322p. and Pt. Ib, 313p.) $3.10(OTS).

Part II(Del.): Division of Reactor Development, AEC, and Public Health Service, Washington, D. C., October 1956. Declassified with deletions Apr. 7, 1959. 28p. $4.80(ph OTS); $2.70(mf OTS).

FIFTH ATOMIC ENERGY COMMISSION AIR CLEANING CONFERENCE Held at the Harvard Air Cleaning Laboratory, June 24–27, 1957
(TID-7551)

Division of Reactor Development, AEC, and Harvard Univ., Boston, School of Public Health. 163p. $2.00(OTS).

SANITARY ENGINEERING CONFERENCE Held at South District Filtration Plant, City of Chicago
(WASH-129)

Division of Reactor Development, AEC, Sept. 11, 1952. 203p. $1.00(OTS).

AIR CLEANING SEMINAR, Ames Laboratory, September 15–17, 1952
(WASH-149)

Ames Lab., Ames, Iowa, March 1954. Changed from Official Use Only June 22, 1956. 243p. $37.80(ph OTS); $11.10(mf OTS).

THIRD ATOMIC ENERGY COMMISSION AIR CLEANING CONFERENCE Held at Los Alamos Scientific Laboratory, September 21, 22, and 23, 1953
[WASH-170(Del.)]

Division of Engineering, AEC, November 1954. Declassified with deletions Mar. 13, 1957. 372p. $59.40(ph OTS); $11.10(mf OTS).

SANITARY ENGINEERING CONFERENCE, Baltimore, Maryland, April 15–16, 1954
(WASH-275)

Division of Reactor Development, AEC, August 1955. 332p. $1.50(OTS).

INSTRUMENTATION

MINUTES OF THE FIFTH TRIPARTITE INSTRUMENTATION CONFERENCE, Brookhaven National Laboratory, October 22–26, 1956
(TID-7543)

Brookhaven National Lab., Upton, N. Y. 184p. $3.00(OTS).

MANAGEMENT

AEC MATERIALS MANAGEMENT–CONTRACTOR REPRESENTATIVES MEETING, Washington, D. C., May 7–9, 1956
[TID-7516(Pt. 1)]

Division of Nuclear Materials Management, AEC. 272p. $1.50(OTS).

CONTROL OVER SOURCE AND SPECIAL NUCLEAR MATERIAL. A Symposium Held at New York, March 5–7, 1957
[TID-7537(Pt. 1)]

Division of Nuclear Materials Management, AEC, and New York Operations Office, AEC. 107p. $3.00(OTS).

AEC AND CONTRACTOR SOURCE AND SPECIAL MATERIALS MANAGEMENT REPRESENTATIVES MEETING. A Conference Held at Washington, D. C., June 17–19, 1957
[TID-7541(Pt. 1)]

Division of Nuclear Materials Management, AEC. 151p. $4.00(OTS).

PAPERS PRESENTED AT THE REACTOR FUEL MEASUREMENT TECHNIQUES SYMPOSIUM, [Held] at Kellogg Center, Michigan State University, East Lansing, Michigan, June 18–20, 1958
(TID-7560)

Division of Nuclear Materials Management, AEC, and Michigan State Univ., East Lansing, Coll. of Engineering. 208p. $2.00(OTS).

METALLURGY

NOTES FROM THE SECOND METALLOGRAPHY CONFERENCE [Held] at Battelle Memorial Institute on January 11, 1950
(AECU-1235)

By H. A. Saller and R. F. Dickerson, Metallurgy Development Advisory Committee, AEC, Jan. 12, 1951. 13p. (OTS).

NOTES TAKEN AT THE METALLURGY CONFERENCE ON DECEMBER 14–15, 1944
(N-1779)

By Paul Lauletta, Chicago, Univ. Metallurgical Lab., Dec. 21, 1944. Declassified Feb. 26, 1957. 14p. $3.30(ph OTS); $2.40(mf OTS).

MINUTES OF ZIRCONIUM CONFERENCE [Held at the New Brunswick Laboratory], August 15, 1949
(NYO-2000)

By Clement J. Rodden, New Brunswick Lab., AEC, N. J. Declassified Jan. 30, 1956. 39p. $6.30(ph OTS); $3.00(mf OTS).

POWDER METALLURGY IN EUROPE; A Trip Report
(SEP-120)

By Henry H. Hausner, Sylvania Electric Products, Inc., Atomic Energy Div., Dec. 31, 1952. 47p. $7.80(ph OTS); $3.30(mf OTS).

PROCEEDINGS OF THE METALLURGY AND MATERIALS INFORMATION MEETING, APRIL 16–18, 1951, Held at Oak Ridge, Tennessee, Sponsored by Oak Ridge National Laboratory. Volume I
[TID-5061(Del.)]

Oak Ridge National Lab., Tenn. Declassified with deletions Mar. 7, 1957. 588p. $100.80 (ph OTS); $11.10(mf OTS).

NOTES FROM THE CONFERENCE ON URANIUM METALLOGRAPHY AT BATTELLE MEMORIAL INSTITUTE ON JULY 10, 1949
(TID-5076)

By R. F. Dickerson, Metallurgy Development Advisory Committee, AEC, Feb. 7, 1952. Declassified Apr. 18, 1955. 19p. $0.20 (OTS).

METALLOGRAPHY OF THORIUM: NOTES FROM THE FIFTH METALLOGRAPHIC CONFERENCE [Held at] Westinghouse Atomic Power Division
(TID-5117)

By R. J. Gray and M. J. Feldman, Metallurgy Development Advisory Committee, AEC, Feb. 14, 1952. Declassified Apr. 18, 1955. 29p. $0.25(OTS).

SYMPOSIUM ON THE PREPARATION AND CHARACTERISTICS OF METAL POWDERS, JANUARY 29–30, 1953, Held at New York and Bayside, N. Y.
[TID-5153(Del.)]

Sylvania Electric Products, Inc., Atomic Energy Div., Bayside, N. Y., and New York Operations Office, AEC, December 1953. Declassified with deletions Mar. 15, 1957. 194p. $28.80(ph OTS); $8.40(mf OTS).

HIGH TEMPERATURE FUEL PROCESSING CONFERENCE Held at Ames Laboratory, November 10-11, 1953
(TID-5189)

Ames Laboratory, Ames, Iowa, Oct. 6, 1954. Declassified Mar. 4, 1957. 40p. $1.25(OTS).

TECHNICAL PAPERS OF THE EIGHTH METALLOGRAPHIC GROUP MEETING Held at the Oak Ridge National Laboratory, December 9 and 10, 1953
[TID-5243(Rev.)]

Compiled by H. P. Roth, Metallurgy Development Advisory Committee, AEC. Declassified Mar. 1, 1957. 64p. $0.50(OTS).

URANIUM INCLUSIONS—TECHNICAL PAPERS OF NINTH METALLOGRAPHIC GROUP MEETING, October 27, 1954 at Battelle Memorial Institute
(TID-5256(Rev.))

Compiled by H. P. Roth, April 26, 1955. Declassified Mar. 1, 1957. 124p. $0.70 (OTS).

THE 1955 MEETING OF AEC WELDING COMMITTEE, SAVANNAH RIVER PLANT, September 7–8, 1955
[TID-7507(Del.)]

Division of Reactor Development, AEC, July 1956. Declassified with deletions Feb. 5, 1957. 248p. $33.30(ph OTS); $9.60(mf OTS).

PAPERS FOR THORIUM–URANIUM-233 INFORMATION MEETING Held at Wilmington, August 3, 1955
[TID-7521[Pt. 1(Del.)]]

Division of Production, AEC, December 1956. Declassified with deletions Mar. 14, 1957. 99p. $15.30(ph OTS); $5.40(mf OTS).

TECHNICAL PAPERS OF THE TENTH METALLOGRAPHIC GROUP MEETING Held at Knolls Atomic Power Laboratory, October 24, 1955
[TID-7523(Pt. 1)]

Compiled by H. P. Roth, Metallurgy Development Advisory Committee, AEC. 100p. $0.70(OTS).

METALLURGY INFORMATION MEETING, Ames Laboratory, Iowa State College, May 2, 3, and 4, 1956
[TID-7526(Pt. 1)]

Ames Lab., Ames, Iowa. 284p. $1.50(OTS).

FUEL ELEMENTS CONFERENCE, Paris, November 18–23, 1957
(TID-7546)

Commissariat a l'Énergie Atomique, Paris, France, and Atomic Energy Commission, Washington, D. C. Issued in two books Bk. 1 (Sessions I–III), 371p., and Bk. 2 (Sessions IV–VII), 448p. $7.00(OTS).

MINUTES OF THE SEVENTH ANNUAL ATOMIC ENERGY COMMISSION WELDING CONFERENCE Held in Chicago, Illinois, November 6–8, 1957
(TID-7562)

Division of Reactor Development, AEC. 257p. $2.50(OTS).

ATOMIC ENERGY COMMISSION WELDING CONFERENCE. MINUTES—AEC WELDING COMMITTEE MEETING, Argonne National Laboratory, November 9 and 10, 1953
[WASH-181(Del.)]

Division of Reactor Development, AEC, Sept. 30, 1954. Declassified with deletions Mar. 10, 1957. 372p. $55.80(ph OTS); $11.10 (mf OTS).

REPORT OF OCTOBER 1954 MEETING OF THE ZIRCONIUM ALLOY CORROSION COMMITTEE
(WAPD-MM-713)

By S. Kass, Westinghouse Electric Corp. Atomic Power Div., Pittsburgh, Nov. 30, 1954. Changed from Official Use Only July 18, 1956. 136p. $21.30(ph OTS); $6.90(mf OTS).

NUCLEAR SAFETY

STUDIES IN NUCLEAR SAFETY. Lectures Presented at the Nuclear Safety Training School Conducted by Union Carbide Nuclear Company, June 3–14, 1957
(K-1380)

Oak Ridge Gaseous Diffusion Plant, Tenn., Aug. 14, 1958. 162p. $3.00(OTS).

REACTOR SAFETY CONFERENCE [Held at] New York City, October 31, 1957
(TID-7549(Pts. I and II))

Part I. American Nuclear Society, Oak Ridge, Tenn.; Atomic Industrial Forum, Inc., New York; and Atomic Energy Commission, Washington, D. C. 45p. $0.75(OTS).

Part II. American Nuclear Society, Oak Ridge, Tenn.; Atomic Industrial Forum, Inc., New York; and Atomic Energy Commission, Washington, D. C. 45p. $1.00(OTS).

PROCEEDINGS OF THE 1958 ATOMIC ENERGY COMMISSION AND CONTRACTOR SAFETY AND FIRE PROTECTION CONFERENCE, Held at Atomic Energy Commission Headquarters Building, Germantown, Maryland, June 24–25, 1958
(TID-7569)

Office of Industrial Relations, Safety and Fire Protection Brance, AEC, May 15, 1959. $2.50(OTS).

NUCLEAR SHIP PROPULSION

NUCLEAR-POWERED SHIPS FOR AMERICAN SHIP OPERATORS. A Symposium Held at Washington, D. C., July 30, 1957
(TID-7539)

Division of Reactor Development, Maritime Reactors Branch, AEC, and Maritime Administration, Washington, D. C. 196p. $5.50 (OTS).

PROCEEDINGS OF THE 1958 NUCLEAR MERCHANT SHIP SYMPOSIUM, Held in Washington, D. C., August 21, 1958
(TID-7563)

Atomic Energy Commission, Washington, D. C., and Maritime Administration, Washington, D. C. 203p. $2.50(OTS).

PHYSICS

STATISTICAL ASPECTS OF THE NUCLEUS. A Conference Held at Brookhaven National Laboratory, January 24 to 26, 1955
(BNL-331)

Edited by R. M. Eisberg, P. C. Gugelot, and C. E. Porter, Brookhaven National Lab., Upton, N. Y., April 1955. 116p. $0.80(OTS).

CONFERENCE ON NUCLEAR AND REACTOR PHYSICS, Oak Ridge National Laboratory, September 10, 11, 12, 1952
[CF-52-9-9(Del.)]

Oak Ridge National Lab., Tenn.; Division of Reactor Development, AEC; and Division of Research, AEC. Declassified with deletions Feb. 6, 1957. 66p. $10.80(ph OTS); $3.90 (mf OTS).

REACTOR PHYSICS AT ORNL (TRIPARTITE CONFERENCE ON NUCLEAR CONSTANTS, Chalk River, Jan. 10–12, 1956
(CF-56-3-44)

By Robert A. Charpie, Oak Ridge National Lab., Tenn. Mar. 7, 1956. 5p. $1.80(ph OTS); $1.80(mf OTS).

CONFERENCE ON NEUTRON PHYSICS BY TIME-OF-FLIGHT Held at Gatlinburg, Tennessee, November 1 and 2, 1956
(ORNL-2309)

Edited by R. C. Block, W. M. Good, J. A. Harvey, H. W. Schmitt, and G. T. Trammell, Oak Ridge National Lab., Tenn., July 1, 1957. 207p. $1.00(OTS).

PAPERS PREPARED FOR RADIATION EFFECTS REVIEW MEETING, Congress Hotel, Chicago, July 31–August 1, 1956
[TID-7515[Pts. 1 and 2(Del.)]]

Part 1. Division of Reactor Development, AEC, August 1956. 49p. $0.35(OTS).

Part 2(Del.). Division of Reactor Development, AEC, August 1956. Declassified with deletions June 13, 1958. 372p. $5.00(OTS).

MODERN APPROACHES TO ISOTOPIC ANALYSIS OF URANIUM. A Conference Held at Chicago, February 5–7, 1957
[TID-7531[Pts. 1 and 2(Del.)]]

Part 1. Division of Nuclear Materials Management, AEC, and Chicago Operations Office, AEC. 180p. $4.75(OTS).

Part 2(Del.). Division of Nuclear Materials Management, AEC, and Chicago Operations Office, AEC. 69p. $10.80(ph OTS); $3.90 (mf OTS).

THE INTERNATIONAL CONFERENCE ON THE NEUTRON INTERACTIONS WITH THE NUCLEUS, Held at Columbia University, September 9–13, 1957
(TID-7547)

Edited by W. W. Havens, Jr., Columbia Univ., New York. 291p. $3.25(OTS).

REACTORS

NOTES ON CONFERENCE ON REACTOR POISONS. Conference Held at WAPD, January 3, 1952
(AECD-3837)

By R. R. Schiff, Westinghouse Electric Corp. Atomic Power Div., Pittsburgh, August 1952. Declassified with deletions Dec. 6, 1955. 13p. $0.15(OTS).

PROCEEDINGS [OF THE] UNIVERSITY RESEARCH REACTOR CONFERENCE Held at Oak Ridge, Tennessee, February 17–18, 1954
(AECU-2900)

Edited by W. W. Grigorieff, Oak Ridge Inst. of Nuclear Studies, Inc., Tenn. 227p. $1.00 (OTS).

REACTOR INFORMATION MEETING, ARGONNE NATIONAL LABORATORY, October 7, 8, 9, 1953. Papers. Part 6. Processing
[ANL-5176[Pt. 6(Del.)]]

Division of Reactor Development, AEC. Declassified with deletions Feb. 11, 1957. 36p. $6.30(ph OTS); $3.00(mf OTS).

THORIUM-U^{233} SYMPOSIUM. Sponsored by the United States Atomic Energy Commission at Brookhaven National Laboratory, January 9 to 10, 1958
(BNL-483)

Brookhaven National Laboratory, Upton, N. Y., December 1958. 200p. $3.50(OTS).

PROCEEDINGS OF THE FRENCH-AMERICAN CONFERENCE ON GRAPHITE REACTORS, Brookhaven National Laboratory, November 12-15, 1957
(BNL-489)

Brookhaven National Laboratory, Upton, N. Y., September 1958. 304p. $5.00(OTS).

REACTOR PHYSICS CONFERENCE [Held at Los Angeles on] October 11, 12, and 13, 1951
[NAA-SR-195(Del.)]

Edited by E. R. Cohen and R. H. Sehnert, North American Aviation, Inc., Downey, Calif., Mar. 10, 1953. Declassified Mar. 4, 1957. 272p. $45.00(ph OTS); $11.10(mf OTS).

PAPERS PRESENTED AT THE TECHNICAL BRIEFING SESSION ON THE BOILING WATER REACTOR PROGRAM AND THE FAST REACTOR PROGRAM, Held at Idaho Falls, Idaho, November 1–2, 1955
[TID-7506(Pts. I and II)]

Part I. Argonne National Lab., Lemont, Ill., July 1956. 221p. $1.25(OTS).

Part II. Argonne National Lab., Lemont, Ill., July 1956. Declassified Jan. 17, 1957. 40p. $0.40(OTS).

HRP CIVILIAN POWER REACTOR CONFERENCE Held at Oak Ridge, March 21–22, 1956
(TID-7524)

Oak Ridge Operations Office, Research and Development Div., AEC, March 1951. 261p. $0.50(OTS).

PROCEEDINGS OF THE SRE–OMRE FORUM Held at Los Angeles, California, November 8 and 9, 1956
(TID-7525)

Atomics International Div., North American Aviation, Inc., Canoga Park, Calif., Jan. 15, 1957. 313p. $1.50(OTS).

REACTOR CONTROL MEETING Held in Los Angeles, March 6–8, 1957
[TID-7532(Pt. 1)]

Division of Reactor Development, AEC, October 1957. 245p. $6.00(OTS).

PAPERS PRESENTED AT THE TECHNICAL BRIEFING SESSION Held at Argonne National Laboratory, May 27–28, 1957. Boiling Water Reactor Program
(TID-7535)

Argonne National Lab., Lemont, Ill. 164p. $4.25(OTS).

HRP CIVILIAN POWER REACTOR CONFERENCE Held at Oak Ridge National Laboratory, May 1–2, 1957
(TID-7540)

Compiled by R. B. Briggs, Oak Ridge National Lab., Tenn., July 1957. 306p. $1.60(OTS).

DESIGN, CONSTRUCTION, AND OPERATION OF ENGINEERING TEST REACTOR. Papers Presented at Engineering Test Reactor Industrial Preview, Idaho Falls, Idaho, October 2 and 3, 1957
(TID-7552)

Idaho Operations Office, AEC, and Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho; Kaiser Engineers Div., Henry J. Kaiser Co., Oakland, Calif.; and General Electric Co. Atomic Power Equipment Dept., Schenectady, N. Y. 218p. $2.50(OTS).

PROCEEDINGS OF THE SRE–OMRE FORUM Held at Los Angeles, California, February 12 and 13, 1958
(TID-7553)

Atomics International Div., North American Aviation, Inc., Canoga Park, Calif. 247p. $3.00(OTS).

INFORMATION MEETING ON GAS-COOLED POWER REACTORS, Oak Ridge National Laboratory, October 21–22, 1958
(TID-7564)

Oak Ridge National Lab., Tenn. 376p. $3.50 (OTS).

SYMPOSIUM ON D_2O-MODERATED POWER REACTORS, Held at the Atomic Energy Commission Headquarters Building, Germantown, Maryland, March 3 and 4, 1959
(TID-7575)

Division of Reactor Development, AEC. (To be published.)

CONFERENCE ON THE USE OF ORGANIC MATERIALS IN NUCLEAR REACTORS, August 5–6, 1953, Downey, California
(TID-10041)

Compiled by R. L. Loftness, North American Aviation, Inc., Downey, Calif., Dec. 1, 1953. Declassified Mar. 9, 1957. 156p. $0.70 (OTS).

REACTOR INFORMATION MEETING AT ARGONNE NATIONAL LABORATORY, October 7, 8, and 9, 1953. Papers, Part V. Heat Transfer
(TID-10087)

Division of Reactor Development, AEC. Declassified Mar. 18, 1957. 94p. $15.30(ph OTS); $5.40(mf OTS).

REACTOR-SHIELDING INFORMATION MEETING, Chicago, November 12 and 13, 1953
[WASH-152(Del.)]

Division of Reactor Development, AEC, Mar. 1954. Declassified with deletions Mar. 6, 1957. 106p. $16.80(ph OTS); $5.70(mf OTS).

PROCEEDINGS OF THE 1957 FAST REACTOR INFORMATION MEETING, Held at Chicago, Ill., November 20–21, 1957, Sponsored by the Civilian Power Reactor Branch of the Reactor Development Division, United States Atomic Energy Commission

Edited by G. W. Wensch, U. S. Atomic Energy Commission, 1959. 282 p. $2.00 (GPO).

WASTE PROCESSING

MINUTES OF MEETING ON WASTE PROCESSING Held at Argonne National Laboratory November 28–29, 1949
(ANL-SL-215)

By W. A. Rodger, P. Fineman, and K. Rhode, Argonne National Lab., Lemont, Ill., Dec. 1, 1949. Declassified Feb. 27, 1957. 11p. $3.30(ph OTS); $2.40(mf OTS).

CONFERENCE ON WASTE PROCESSING [Held at Brookhaven National Laboratory] March 27–28, 1950. Section 2. EVAPORATION
(BNL-59)

Waste Processing Committee, AEC. Changed from Official Use Only Oct. 3, 1956. 43p. $7.80(ph OTS); $3.30(mf OTS).

MEETING OF THE AEC WASTE PROCESSING COMMITTEE, June 26–28, 1950. Part II. COPRECIPITATION AS A METHOD OF WASTE DISPOSAL
[KAPL-364(Pt. II)]

Edited by J. A. Ayres, Knolls Atomic Power Lab., Schenectady, N. Y., Apr. 25, 1951. Changed from Official Use Only Sept. 9, 1957. 35p. $7.80(ph OTS); $3.30(mf OTS).

MINUTES OF CONFERENCE ON LIQUID WASTE DISPOSAL, August 23–25, 1948
(ORNL-163)

Oak Ridge National Lab., Tenn., Nov. 2, 1948. Declassified Jan. 13, 1956. 43p. $7.80(ph OTS); $3.30(mf OTS).

REPORT OF WORKING MEETING ON FIXATION OF RADIOACTIVITY IN STABLE, SOLID MEDIA at the Johns Hopkins University, June 19–21, 1957
(TID-7550)

By James M. Morgan, Jr., Division of Reactor Development, AEC. 112p. $2.50(OTS).

ATTACHMENT TWO

TITLE EXCERPTS FROM TECHNICAL BOOKS, USAEC

PART I

Technical Books Published

GENERAL REFERENCE

ATOMIC ENERGY FACTS

U. S. Atomic Energy Commission, Washington, 1957.

216 pp., with illus., 7⅞ × 10¼, $2.00. (Available from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C.)

ATOMS FOR PEACE*

U. S. Atomic Energy Commission, Washington, D. C., 1955.

156 pp., 31 illus., 8¼ × 10½.

ATOMS FOR PEACE: U. S. A. 1958†

Edited by J. F. Hogerton, Arthur D. Little, Inc., Cambridge, Mass.
U. S. Atomic Energy Commission, Washington, 1958.

162 pp., well illustrated, 9 × 12, $4.50. (Available from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C.)

ATOMS FOR THE WORLD

By Laura Fermi, historian for the U. S. delegation to the First International Conference on the Peaceful Uses of Atomic Energy, Geneva, 1955.
The University of Chicago Press, Chicago, Ill., 1955.

227 pp., 34 illus., 6¼ × 9¼, $3.75.

THE EFFECTS OF NUCLEAR WEAPONS

Edited by Samuel Glasstone, consultant to the U. S. Atomic Energy Commission.
U. S. Atomic Energy Commission, Washington, 1957.

579 pp., well illus., 5⅞ × 9¼, $2.00. (Available from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C.)

ENERGY IN THE FUTURE

By P. C. Putnam, consultant to the U. S. Atomic Energy Commission.
D. Van Nostrand Company, Inc., Princeton, N. J., 1953.

558 pp., 160 illus., 6 × 9, $12.75.

INFORMATION SOURCES*

U. S. Atomic Energy Commission, Washington, D. C., 1955.

160 pp., 1 illus., 8¼ × 10½.

SOURCEBOOK ON ATOMIC ENERGY

By Samuel Glasstone, consultant to the U. S. Atomic Energy Commission.
D. Van Nostrand Company, Inc., Princeton, N. J., 1958.

641 pp., well illustrated, 6¼ × 9¼, $4.40.

BIOLOGY AND MEDICINE

BIOLOGICAL EFFECTS OF EXTERNAL BETA RADIATION††

Edited by R. E. Zirkle, Institute of Radiobiology and Biophysics, University of Chicago.
McGraw-Hill Book Co., Inc., New York, 1951.

242 pp., 82 illus., 6¼ × 9¼, $3.50.

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*Prepared by the Atomic Energy Commission for the First Atoms for Peace Conference in Geneva in 1955.

†A U. S. Government presentation volume for the International Conference on the Peaceful Uses of Atomic Energy, Geneva, 1958.

††This is a volume in the National Nuclear Energy Series, written by scientists who performed research and development work on the atomic energy enterprise under the Manhattan Engineer District and later under the Atomic Energy Commission.

BIOLOGICAL EFFECTS OF EXTERNAL RADIATION*

Edited by H. A. Blair, University of Rochester School of Medicine and Dentistry.
McGraw-Hill Book Co., Inc., New York, 1954.
508 pp., 174 illus., 6¼ × 9¼, $7.00.

BIOLOGICAL EFFECTS OF EXTERNAL X AND GAMMA RADIATION (Part I)*

Edited by R. E. Zirkle, Institute of Radiobiology and Biophysics, University of Chicago.
McGraw-Hill Book Co., Inc., New York, 1954.
530 pp., 246 illus., 6¼ × 9¼, $7.25.

BIOLOGICAL STUDIES WITH POLONIUM, RADIUM, AND PLUTONIUM*

Edited by R. M. Fink, University of California at Los Angeles.
McGraw-Hill Book Co., Inc., New York, 1950.
411 pp., 96 illus., 6¼ × 9¼, $5.50.

HISTOPATHOLOGY OF IRRADIATION FROM EXTERNAL AND INTERNAL SOURCES*

Edited by William Bloom, University of Chicago.
McGraw-Hill Book Co., Inc., New York, 1948.
808 pp., 548 illus., 6¼ × 9¼, $10.75.

INDUSTRIAL MEDICINE ON THE PLUTONIUM PROJECT: Survey and Collected Papers*

Edited by R. S. Stone, University of California School of Medicine.
McGraw-Hill Book Co., Inc., New York, 1951.
511 pp., 118 illus., 6¼ × 9¼, $7.00.

MEDICAL EFFECTS OF THE ATOMIC BOMB IN JAPAN*

Edited by A. W. Oughterson, Yale University School of Medicine, and Shields Warren, New England Deaconess Hospital.
McGraw-Hill Book Co., Inc., New York, 1956.
477 pp., 324 illus., 6¼ × 9¼, $8.00.

PHARMACOLOGY AND TOXICOLOGY OF URANIUM COMPOUNDS (Parts I and II)*

Edited by Carl Voegtlin and H. C. Hodge, University of Rochester.
McGraw-Hill Book Co., Inc., New York, 1949.
1084 pp., 373 illus., 6¼ × 9¼, $14.25.

PHARMACOLOGY AND TOXICOLOGY OF URANIUM COMPOUNDS (Parts III and IV)*

Edited by Carl Voegtlin and H. C. Hodge, University of Rochester.
McGraw-Hill Book Co., Inc., New York, 1953.
1379 pp., 510 illus., 6¼ × 9¼, $18.00.

RADIATION BIOLOGY AND MEDICINE: Selected Reviews in the Life Sciences†

Edited by W. D. Claus, Division of Biology and Medicine, U. S. Atomic Energy Commission.
Addison-Wesley Publishing Co., Inc., Reading, Mass., 1958.
968 pp., 198 illus., 6¼ × 9¼, $11.50.

RADIOISOTOPE SCANNING

By Marshall Brucer, Oak Ridge Institute of Nuclear Studies.
U. S. Atomic Energy Commission, Washington, D. C., 1958.
169 pp., 69 illus., 8 × 10½, $1.00. (Available from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C., as ORINS-20.)

RADIOISOTOPES IN MEDICINE

Edited by G. A. Andrews, Marshall Brucer, and Elizabeth B. Anderson, Oak Ridge Institute of Nuclear Studies.
U. S. Atomic Energy Commission, Washington, 1953.
817 pp., 552 illus., 7½ × 10¼, $5.50 (Available from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C., as ORO-125.)

SOME EFFECTS OF IONIZING RADIATION ON HUMAN BEINGS

Edited by E. P. Cronkite and V. P. Bond, Brookhaven National Laboratory, and C. L. Dunham, U. S. Atomic Energy Commission.
U. S. Atomic Energy Commission, Washington, 1956.
106 pp., 57 illus. (29 of these, color plates), 8 × 10½, $1.25. (Available from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C., as TID-5358.)

TOXICOLOGY OF URANIUM: Survey and Collected Papers*

Edited by Albert Tannenbaum, Medical Research Institute, Michael Reese Hospital, Chicago.
McGraw-Hill Book Co., Inc., New York, 1951.
333 pp., 77 illus., 6¼ × 9¼, $4.75.

CHEMISTRY

THE ACTINIDE ELEMENTS*

Edited by G. T. Seaborg, Radiation Laboratory, University of California, and J. J. Katz, Chemistry Division, Argonne National Laboratory.
McGraw-Hill Book Co., Inc., New York, 1954.
870 pp., 150 illus., 6¼ × 9¼, $11.75.

*This is a volume in the National Nuclear Energy Series, written by scientists who performed research and development work on the atomic energy enterprise under the Manhattan Engineer District and later under the Atomic Energy Commission.

†A U. S. Government presentation volume for the International Conference on the Peaceful Uses of Atomic Energy, Geneva, 1958.

ANALYTICAL CHEMISTRY OF THE MANHATTAN PROJECT*

By C. J. Rodden, New Brunswick Laboratory, U. S. Atomic Energy Commission. McGraw-Hill Book Co., Inc., New York, 1950.

748 pp., 151 illus., 6¼ × 9¼, $10.00.

BIBLIOGRAPHY OF RESEARCH ON HEAVY HYDROGEN COMPOUNDS*

Compiled by Alice H. Kimball, formerly at SAM Laboratories, Columbia University. McGraw-Hill Book Co., Inc., New York, 1949.

350 pp., 6¼ × 9¼, $4.75.

CHEMICAL PROCESSING AND EQUIPMENT†

Staffs, National Reactor Testing Station and Brookhaven National Laboratory. McGraw-Hill Book Co., Inc., New York, 1955.

302 pp., 211 illus., 8 × 10½, $6.00. [Also available from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C., as TID-5276 (paperbound), $2.00.]

THE CHEMISTRY AND METALLURGY OF MISCELLANEOUS MATERIALS: THERMODYNAMICS*

Edited by L. L. Quill, Department of Chemistry, Michigan State College. McGraw-Hill Book Co., Inc., New York, 1950.

329 pp., 26 illus., 6¼ × 9¼, $4.50.

THE CHEMISTRY OF URANIUM: PART I. THE ELEMENT, ITS BINARY AND RELATED COMPOUNDS*

By J. J. Katz, Chemistry Division, Argonne National Laboratory, and Eugene Rabinowitch, University of Illinois. McGraw-Hill Book Co., Inc., New York, 1951.

609 pp., 69 illus., 6¼ × 9¼, $8.25.

CONSTITUTION OF URANIUM AND THORIUM ALLOYS

Compiled by P. A. Rough and A. A. Bauer, Battelle Memorial Institute. U. S. Atomic Energy Commission, Washington, 1958.

138 pp., 8 × 11½, $2.75 (spiral binding). (Available from the Office of Technical Services, Department of Commerce, Washington 25, D. C., as BMI-1300; commercial edition to be made available by Addison-Wesley Publishing Co., Inc., Reading, Mass., 1959, $5.00.)

EIGHT-YEAR ISOTOPE SUMMARY†

U. S. Atomic Energy Commission, Washington, D. C., 1955.

357 pp., 53 illus., 8¼ × 10½, $2.00. (Available from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C.)

HOT LABORATORY EQUIPMENT

Compiled by L. G. Stang, Jr., Brookhaven National Laboratory. U. S. Atomic Energy Commission, Washington, 1958.

426 pp., 351 illus., 7⅞ × 10½, $2.50. (Available from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C.)

LIQUID THERMAL DIFFUSION

Edited by P. H. Abelson, Carnegie Institution of Washington, Nathan Rosen, University of North Carolina, and J. I. Hoover, Naval Research Laboratory. U. S. Atomic Energy Commission, Washington, 1958.

251 pp., 74 illus., 6 × 9, $4.00. (Available from the Office of Technical Services, Department of Commerce, Washington 25, D. C., as TID-5229.)

ORNL MASTER ANALYTICAL MANUAL. SECTION 1. IONIC METHODS

Staff, Oak Ridge National Laboratory. U. S. Atomic Energy Commission, Washington, 1958.

1600 pp., with illustrations, 8½ × 11, $9.00. [Available from the Office of Technical Services, Department of Commerce, Washington 25, D. C., as TID-7015(Sec. 1).]

ORNL MASTER ANALYTICAL MANUAL. SECTION 2. RADIOCHEMICAL METHODS

Staff, Oak Ridge National Laboratory. U. S. Atomic Energy Commission, Washington, 1957.

304 pp., with illustrations, 8½ × 11, $6.50. [Available from the Office of Technical Services, Department of Commerce, Washington 25, D. C., as TID-7015(Sec. 2).]

Gives procedures for radiochemical methods.

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*This is a volume in the National Nuclear Energy Series, written by scientists who performed research and development work on the atomic energy enterprise under the Manhattan Engineer District and later under the Atomic Energy Commission.

†Prepared by the Atomic Energy Commission for the First Atoms for Peace Conference in Geneva in 1955.

ORNL MASTER ANALYTICAL MANUAL. SECTION 3. SPECTROGRAPHIC METHODS. SECTION 5. NUCLEAR ANALYSES METHODS

Staff, Oak Ridge National Laboratory.
U. S. Atomic Energy Commission, Washington, 1957.

157 pp., with illustrations, 8½ × 11, $4.50. [Available from the Office of Technical Services, Department of Commerce, Washington 25, D. C., as TID-7015(Secs. 3 and 5).]

PREPARATION, PROPERTIES, AND TECHNOLOGY OF FLUORINE AND ORGANIC FLUORO COMPOUNDS*

Edited by Charles Slesser and S. R. Schram, New York Operations Office, U. S. Atomic Energy Commission.
McGraw-Hill Book Co., Inc., New York, 1951.

868 pp., 241 illus., 6¼ × 9¼, $11.50.

PRODUCTION OF HEAVY WATER*

Edited by G. M. Murphy, Washington Square College, New York University, H. C. Urey, Institute for Nuclear Studies, University of Chicago, and Isidor Kirshenbaum, Esso Laboratories, Standard Oil Development Company.
McGraw-Hill Book Co., Inc., New York, 1955.

394 pp., 97 illus., 6¼ × 9¼, $5.25.

RADIOCHEMICAL STUDIES: THE FISSION PRODUCTS*

Edited by C. D. Coryell, Laboratory for Nuclear Science and Engineering, Massachusetts Institute of Technology, and Nathan Sugarman, Institute for Nuclear Studies, University of Chicago.
McGraw-Hill Book Co., Inc., New York, 1951.

2086 pp., 682 illus., 6¼ × 9¼, $27.75.

THORIUM PRODUCTION TECHNOLOGY†

By F. L. Cuthbert, National Lead Company of Ohio.
Addison-Wesley Publishing Co., Inc., Reading, Mass., 1958.

320 pp., 84 illus., 6¼ × 9¼, $6.50.

THE TRANSURANIUM ELEMENTS: Research Papers*

Edited by G. T. Seaborg, Radiation Laboratory, University of California, J. J. Katz, Chemistry Division, Argonne National Laboratory, and W. M. Manning, Chemistry Division, Argonne National Laboratory.
McGraw-Hill Book Co., Inc., New York, 1949.

1733 pp., 400 illus., 6¼ × 9¼, $23.75.

TRILINEAR CHART OF NUCLIDES

Prepared by W. H Sullivan, Oak Ridge National Laboratory.
U. S. Atomic Energy Commission, Washington, 1957.

9 sheets, each 11½ in. high (can be used in book form or assembled as wall chart), $2.00. (Available from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C.)

ENGINEERING

CRYOGENIC ENGINEERING

By R. B. Scott, Chief, Cryogenic Engineering Laboratory, National Bureau of Standards, Boulder, Colo.
D. Van Nostrand Co., Inc., Princeton, N. J., 1959.

375 pp., 207 illus., 6¼ × 9¼, $5.60.

ENGINEERING DEVELOPMENTS IN THE GASEOUS DIFFUSION PROCESS*

Edited by Manson Benedict, Hydrocarbon Research, Inc., and Clarke Williams, Brookhaven National Laboratory.
McGraw-Hill Book Co., Inc., New York, 1949.

129 pp., 44 illus., 6¼ × 9¼, $2.00.

VACUUM EQUIPMENT AND TECHNIQUES*

Edited by A. Guthrie, Radiation Laboratory, University of California, and R. K. Wakerling, Radiation Laboratory, University of California.
McGraw-Hill Book Co., Inc., New York, 1949.

264 pp., 105 illus., 6¼ × 9½, $3.75.

INSTRUMENTATION

ELECTRONICS: Experimental Techniques*

By W. C. Elmore, Swarthmore College, and Matthew Sands, Massachusetts Institute of Technology.
McGraw-Hill Book Co., Inc., New York, 1949.

417 pp., 182 illus., 6¼ × 9¼, $5.50.

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*This is a volume in the National Nuclear Energy Series, written by scientists who performed research and development work on the atomic energy enterprise under the Manhattan Engineer District and later under the Atomic Energy Commission.

†A U. S. Government presentation volume for the International Conference on the Peaceful Uses of Atomic Energy, Geneva, 1958.

IONIZATION CHAMBERS AND COUNTERS: Experimental Techniques*

By B. B. Rossi, Massachusetts Institute of Technology, and H. H. Staub, Stanford University.
McGraw-Hill Book Co., Inc., New York, 1949.

243 pp., 148 illus., 6¼ × 9¼, $3.25.

OPTICAL INSTRUMENTATION*

Edited by G. S. Monk, University of Chicago, and W. H. McCorkle, Argonne National Laboratory.
McGraw-Hill Book Co., Inc., New York, 1954.

262 pp., 123 illus., 6¼ × 9¼, $3.75.

METALLURGY

LIQUID-METALS HANDBOOK (2d Ed.)

Edited by R. N. Lyon, Oak Ridge National Laboratory.
U. S. Atomic Energy Commission, Washington, 1952.

269 pp., with illus., 7⅞ × 10¼, $1.00. (Available from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C.)

LIQUID-METALS HANDBOOK: Sodium (NaK) Supplement

Edited by C. B. Jackson, Mine Safety Appliances Company.
U. S. Atomic Energy Commission, Washington, 1955.

445 pp., with illus., 7⅞ × 10¼, $2.00. (Available from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C., as TID-5277.)

THE METAL BERYLLIUM

Edited by D. W. White, Jr., Knolls Atomic Power Laboratory, and J. E. Burke, Research Laboratory, General Electric Co., Schenectady, N. Y.
American Society for Metals, Cleveland, Ohio, 1955.

703 pp., 403 illus., 6¼ × 9¼, $8.00.

THE METAL THORIUM

Edited by H. A. Wilhelm, Iowa State College.
American Society for Metals, Cleveland, Ohio, 1958.

397 pp., 179 illus., 6 × 9⅛, $10.00.

THE METALLURGY OF ZIRCONIUM*

Edited by Benjamin Lustman, Westinghouse Electric Corp., Atomic Power Division, and Frank Kerze, Jr., Reactor Development Division, Atomic Energy Commission.
McGraw-Hill Book Co., Inc., New York, 1955.

776 pp., 316 illus., 6¼ × 9¼, $10.00.

NUCLEAR REACTOR METALLURGY

By W. D. Wilkinson and W. F. Murphy, International School of Nuclear Science and Engineering, and W. J. McGonnagle, Metallurgy Division, Argonne National Laboratory.
D. Van Nostrand Company, Inc., Princeton, N. J., 1958.

382 pp., 179 illus., 6¼ × 9¼, $5.60.

PHYSICAL METALLURGY OF URANIUM†

By A. N. Holden, Vallecitos Atomic Laboratory, General Electric Company.
Addison-Wesley Publishing Co., Inc., Reading, Mass., 1958.

272 pp., 190 illus., 6¼ × 9¼, $5.75.

URANIUM PRODUCTION TECHNOLOGY

Edited by C. D. Harrington and A. E. Ruehle, Mallinckrodt Chemical Works, with contributions from others.
D. Van Nostrand Co., Inc., Princeton, N. J., 1959.

550 pp., 346 illus., 6¼ × 9¼, about $17.50.

PHYSICS

THE CHARACTERISTICS OF ELECTRICAL DISCHARGES IN MAGNETIC FIELDS*

Edited by A. Guthrie, Radiation Laboratory, University of California, and R. A. Wakerling, Radiation Laboratory, University of California.
McGraw-Hill Book Co., Inc., New York, 1949.

376 pp., 236 illus., 6¼ × 9¼, $5.00.

HANDBOOK ON AEROSOLS

U. S. Atomic Energy Commission, Washington, D. C., 1950.

147 pp., 118 illus., 7¾ × 10¼, $0.60. (Available from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C.)

*This is a volume in the National Nuclear Energy Series, written by scientists who performed research and development work on the atomic energy enterprise under the Manhattan Engineer District and later under the Atomic Energy Commission.

†A U. S. Government presentation volume for the International Conference on the Peaceful Uses of Atomic Energy, Geneva, 1958.

INTRODUCTION TO THE THEORY OF NEUTRON DIFFUSION (Volume I)

By K. M. Case, University of Michigan; F. de Hoffmann, Los Alamos Scientific Laboratory; and G. Placzek, Institute for Advanced Study.
U. S. Atomic Energy Commission, Washington, D. C., 1953.

174 pp., 45 illus., 8¼ × 10½, $1.25. (Available from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C.)

METEOROLOGY AND ATOMIC ENERGY

Prepared by the U. S. Department of Commerce, Weather Bureau.
U. S. Atomic Energy Commission, Washington, 1955.

169 pp., 109 illus., 7¾ × 10¼, $1.00. (Available from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C.)

MISCELLANEOUS PHYSICAL AND CHEMICAL TECHNIQUES OF THE LOS ALAMOS PROJECT: Experimental Techniques*

Edited by A. C. Graves, Los Alamos Scientific Laboratory, and D. K. Froman, Los Alamos Scientific Laboratory.
McGraw-Hill Book Co., Inc., New York, 1952.

323 pp., 169 illus., 6¼ × 9¼, $3.25.

NEUTRON CROSS SECTIONS

By D. J. Hughes and R. B. Schwartz, Brookhaven National Laboratory.
U. S. Atomic Energy Commission, Washington, 1958.

373 pp., 292 illus., 10½ × 15⅝, $4.50. [Available from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C., as BNL-325 (second edition).]

NUCLEAR LEVEL SCHEMES

Prepared by K. Way, R. W. King, C. L. McGinnis, and R. van Lieshout, National Academy of Sciences, National Research Council.
U. S. Atomic Energy Commission, Washington, 1955.

240 pp., numerous diagrams, 8½ × 10½, $1.75. (Available from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C., as TID-5300.)

THE PHYSICS OF INTERMEDIATE SPECTRUM REACTORS

Edited by J. R. Stehn, Knolls Atomic Power Laboratory.
U. S. Atomic Energy Commission, Washington, 1959.

487 pp., 242 illus., 8 × 10½, $3.00 (paperbound). (Available from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C.)

PROJECT SHERWOOD—THE U. S. PROGRAM IN CONTROLLED FUSION†

By Amasa Bishop, AEC's European Scientific Representative, Paris, France.
Addison-Wesley Publishing Co., Inc., Reading, Mass., 1958.

228 pp., 58 illus., 6¼ × 9¼, $5.75.

SPECTROSCOPIC PROPERTIES OF URANIUM COMPOUNDS*

By G. H. Dieke, The Johns Hopkins University, and A. B. F. Duncan, University of Rochester.
McGraw-Hill Book Co., Inc., New York, 1949.

290 pp., 22 illus., 6¼ × 9¼, $4.25.

THE THEORY OF ISOTOPE SEPARATION AS APPLIED TO THE LARGE-SCALE PRODUCTION OF U^{235}*

By Karl Cohen, The H. K. Ferguson Company.
McGraw-Hill Book Co., Inc., New York, 1951.

165 pp., 34 illus., 6¼ × 9¼, $2.50.

RAW MATERIALS

CONTRIBUTIONS TO THE GEOLOGY OF URANIUM AND THORIUM BY THE UNITED STATES GEOLOGICAL SURVEY AND ATOMIC ENERGY COMMISSION

Compiled by L. R. Page, H. E. Stocking, and Harriet B. Smith.
U. S. Geological Survey and U. S. Atomic Energy Commission, 1956.

739 pp., 230 illus. (plus 3 folded maps), 9¼ × 11⅞, $6.00. (Available from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C., as Geological Survey Professional Paper 300.)

*This is a volume in the National Nuclear Energy Series, written by scientists who performed research and development work on the atomic energy enterprise under the Manhattan Engineer District and later under the Atomic Energy Commission.

†A U. S. Government presentation volume for the International Conference on the Peaceful Uses of Atomic Energy, Geneva, 1958.

PROSPECTING FOR URANIUM

U. S. Atomic Energy Commission and U. S. Geological Survey, 1957.

228 pp., 11 illus., 4½×5¾, $0.75. (Available from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C.)

RAW MATERIALS DEVELOPMENT LABORATORY HANDBOOK OF ANALYTICAL METHODS

Compiled and edited by M. A. DeSesa, National Lead Company, Inc.
U. S. Atomic Energy Commission, Washington, 1957.

140 pp., 13 illus., 8½ × 10¾, $3.75. [Available from the Office of Technical Services, Department of Commerce, Washington 25, D. C., as TID-7002(Rev. I).]

URANIUM ORE PROCESSING*

Edited by J. W. Clegg and D. D. Foley, Battelle Memorial Institute.
Addison-Wesley Publishing Co., Inc., Reading, Mass., 1958.

448 pp., 118 illus., 6¼ × 9¼, $7.50.

REACTORS

THE ATTENUATION OF GAMMA RAYS AND NEUTRONS IN REACTOR SHIELDS

By Herbert Goldstein, Nuclear Development Corporation of America.
U. S. Atomic Energy Commission, Washington, 1957.

295 pp., 95 illus., 7⅞ × 10¼, $2.00. (Available from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C., as NDA-34.)

BOILING WATER REACTORS*

By A. W. Kramer, editor of *Atomics* and formerly editor of *Power Engineering*.
Addison-Wesley Publishing Co., Inc., Reading, Mass., 1958.

592 pp., 292 illus., 6¼ × 9¼, $8.50.

CORROSION AND WEAR HANDBOOK FOR WATER-COOLED REACTORS

Edited by D. J. DePaul, Westinghouse Electric Corp., Bettis Plant.
McGraw-Hill Book Co., Inc., New York, 1957.

393 pp., 152 illus., 7⅞ × 10¼, $6.00. (Also available from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C., as TID-7004, $2.25.)

THE ELEMENTS OF NUCLEAR REACTOR THEORY

By Samuel Glasstone, consultant to the U. S. Atomic Energy Commission, and M. C. Edlund, Oak Ridge National Laboratory.
D. Van Nostrand Co., Inc., Princeton, N. J., 1952.

416 pp., 85 illus., 6 × 9¼, $4.80.

THE EXPERIMENTAL BOILING WATER REACTOR (EBWR)

Staff, Argonne National Laboratory.
U. S. Atomic Energy Commission, Washington, 1957.

233 pp., 179 illus., 7⅞ × 10¼, $2.25. (Available from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C., as ANL-5607.)

FLUID FUEL REACTORS*

Edited by J. A. Lane and H. G. MacPherson, Oak Ridge National Laboratory, and Frank Maslan, Brookhaven National Laboratory.
Addison-Wesley Publishing Co., Inc., Reading, Mass., 1958.

1008 pp., 336 illus., 6¼ × 9¼, $11.50.

MATERIALS TESTING REACTOR PROJECT HANDBOOK

Edited by J. H. Buck, Oak Ridge National Laboratory, and C. F. Leyse, Argonne National Laboratory.
U. S. Atomic Energy Commission, Washington, 1951.

572 pp., 239 illus., 10¾ × 8½, $2.45. (Available from the Office of Technical Services, Department of Commerce, Washington 25, D. C., as TID-7001.)

NEUTRON AND GAMMA IRRADIATION FACILITIES

Compiled by F. G. Minuth and J. H. Martens, Argonne National Laboratory.
U. S. Atomic Energy Commission, Washington, 1957.

79 pp., 19 illus., 7⅞×10¼, $0.60. (Available from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C.)

NUCLEAR REACTOR EXPERIMENTS

Edited by J. B. Hoag, Argonne National Laboratory.
D. Van Nostrand Co., Inc., Princeton, N. J., 1956.

480 pp., 234 illus., 6¼ × 9¼, $6.75.

*A U. S. Government presentation volume for the International Conference on the Peaceful Uses of Atomic Energy, Geneva, 1958.

POWER REACTORS

U. S. Atomic Energy Commission, Washington, 1958.

92 pp., 75 illus., 7⅞ × 10¾, $0.65. (Available from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C.)

PRINCIPLES OF NUCLEAR REACTOR ENGINEERING

By Samuel Glasstone, consultant to the U. S. Atomic Energy Commission.
D. Van Nostrand Co., Inc., Princeton, N. J., 1955.

861 pp., well illus., 6¼ × 9¼, $7.95.

REACTOR HANDBOOK (1st Ed.)

Editorial coordinators, J. F. Hogerton and R. C. Grass, Vitro Corporation of America, McGraw-Hill Book Co., Inc., New York, 1955.

2475 pp., 876 illus., 3 vols., 7⅞ × 10¼, $37.50. [Also available from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C.: Vol. I (AECD-3645), 790 pp., 186 illus., 7⅞ × 10¼ (paper-bound), $4.25; Vol. II (AECD-3646), 1088 pp., 447 illus., 7⅞ × 10¼ (paper-bound), $5.50; Vol. III (AECD-3647), 614 pp., 243 illus., 7⅞ × 10¼ (paper-bound), $3.50.]

REACTOR MATERIALS SPECIFICATIONS

Compiled and edited by R. M. Evans, Oak Ridge National Laboratory.
U. S. Atomic Energy Commission, Washington, 1958.

246 pp., 31 illus., 8 × 10½, $4.00. (Available from the Office of Technical Services, Department of Commerce, Washington 25, D. C., as TID-7017.)

REACTOR SHIELDING DESIGN MANUAL

Edited by Theodore Rockwell III, Naval Reactors Branch, Division of Reactor Development, U. S. Atomic Energy Commission.
McGraw-Hill Book Co., Inc., New York, 1956.
D. Van Nostrand Co., Inc., Princeton, N. J., 1956.

McGraw-Hill: 488 pp., $6.00.
D. Van Nostrand: 472 pp., $6.00.

RESEARCH REACTORS*

Compiled by North American Aviation, Inc., Oak Ridge National Laboratory, National Reactor Testing Station, Knolls Atomic Power Laboratory, Argonne National Laboratory, and Brookhaven National Laboratory.
U. S. Atomic Energy Commission, Washington, 1955.

443 pp., 393 illus., 8¼ × 10½, $2.00. (Available from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C.)

THE SHIPPINGPORT PRESSURIZED WATER REACTOR†

By personnel of the Naval Reactors Branch, Division of Reactor Development, U. S. Atomic Energy Commission; Bettis Plant Westinghouse Electric Corp.; and Duquesne Light Co.
Addison-Wesley Publishing Co., Inc., Reading, Mass., 1958.

600 pp., 163 illus., 6¼ × 9¼, $9.50.

SODIUM GRAPHITE REACTORS†

By Chauncey Starr and R. W. Dickinson, Atomics International, a division of North American Aviation.
Addison-Wesley Publishing Co., Inc., Reading, Mass., 1958.

304 pp., 99 illus., 6¼ × 9¼, $6.50.

SOLID FUEL REACTORS†

By J. R. Dietrich and W. H. Zinn, General Nuclear Engineering Corporation.
Addison-Wesley Publishing Co., Inc., Reading, Mass., 1958.

864 pp., 385 illus., 6¼ × 9¼, $10.75.

U. S. RESEARCH REACTOR OPERATION AND USE†

Edited by J. W. Chastain, Jr., Battelle Memorial Institute.
Addison-Wesley Publishing Co., Inc., Reading, Mass., 1958.

384 pp., 181 illus., 6¼ × 9¼, $7.50.

U. S. RESEARCH REACTORS

Edited by J. W. Chastain, Jr., Battelle Memorial Institute.
U. S. Atomic Energy Commission, Washington, 1957.

73 pp., 116 illus., 8½ × 11, $1.50. (Available from the Office of Technical Services, Department of Commerce, Washington 25, D. C.)

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*Prepared by the Atomic Energy Commission for the First Atoms for Peace Conference in Geneva in 1955.

†A U. S. Goverament presentation volume for the International Conference on the Peaceful Uses of Atomic Energy, Geneva, 1958.

PART II

Technical Books in Press or in Preparation

CHEMISTRY

EFFECTS OF RADIATION ON ORGANIC MATERIALS

By James Carroll and Robert Bolt, California Research Corporation; with contributions from others.

(Detailed outline completed; work started on individual chapters. To be ready for the publisher during fall of 1959.)

ORNL MASTER ANALYTICAL MANUAL. SECTION 9. PROCESS METHODS

Staff, Oak Ridge Laboratory.
U. S. Atomic Energy Commission, Washington.

Approximately 917 pp., with illustrations, $8\frac{1}{2} \times 11$, $9.00. (Scheduled for publication in summer of 1959; to be available from the Office of Technical Services, Department of Commerce, Washington 25, D. C.)

ENGINEERING

COMMERCIAL NUCLEAR SHIP PROPULSION

By A. W. Kramer, editor of *Atomics* and formerly editor of *Power Engineering*.

(Writing started; to be ready for publisher during the winter 1959–1960.)

ENGINEERING FOR NUCLEAR REACTOR FUEL PROCESSING

By F. L. Culler, J. T. Long, W. L. Carter, and A. M. Rom, Oak Ridge National Laboratory.

(Writing underway; to be ready for publisher during fall of 1959.)

PIPING HANDBOOK FOR PRESSURIZED WATER NUCLEAR POWER PLANTS

Edited by M. Shaw, Naval Reactors Branch, Division of Reactor Development, U. S. Atomic Energy Commission.

(To be ready for publisher in summer of 1959.)

TECHNIQUES OF CONDUCTING IRRADIATION EFFECTS EXPERIMENTS

By H. W. Etherington and others of ACF Industries, Inc.

(In preparation; to be ready for publisher in fall of 1959.)

MANAGEMENT

MANAGEMENT OF NUCLEAR MATERIALS

By R. F. Lumb, Quantum, Inc.; with contributions from others.

(Manuscript nearing completion; to be ready for publisher in summer of 1959.)

RADIATION SAFETY FOR INDUSTRIAL MANAGEMENT

By Staff, National Industrial Conference Board.

(Being written; to be ready for publisher in spring of 1960.)

METALLURGY

METALLURGY AND FABRICATION OF FUEL ELEMENTS

By A. R. Kaufmann and others of Nuclear Metals, Inc.

(Writing nearing completion; to be ready for publisher during the summer of 1959.)

THE METALLURGY OF HAFNIUM

Edited by D. E. Thomas, Bettis Plant, Westinghouse Electric Corp., and E. T. Hayes, Bureau of Mines, U. S. Department of the Interior (under sponsorship of AEC's Naval Reactors Branch).

(To be ready for publisher in spring of 1959.)

PROPERTIES OF URANIUM DIOXIDE

Edited by J. Belle, Bettis Plant, Westinghouse Electric Corp.; contributions from other authorities (under sponsorship of AEC's Naval Reactors Branch).

(To be ready for publisher in summer of 1959.)

PHYSICS

CONTROLLED THERMONUCLEAR REACTIONS

By Samuel Glasstone, consultant to the U. S. Atomic Energy Commission.

(Writing begun; to be ready for publisher during winter of 1959–1960.)

IRRADIATION TESTING AND HOT LAB TECHNIQUES

Edited by D. M. Wroughton, Bettis Plant, Westinghouse Electric Corp., T. J. Glasson, Knolls Atomic Power Laboratory, General Electric Co., and R. R. Roof, Naval Reactors Branch, Division of Reactor Development, U. S. Atomic Energy Commission (under sponsorship of AEC's Naval Reactors Branch).

(To be ready for publisher in spring of 1960.)

NUCLEAR RADIATIONS IN SCIENCE AND INDUSTRY

By L. E. Brownell, University of Michigan.

(Nearing completion; to be ready for publisher in fall of 1959.)

REACTORS

ANALYSIS OF ESSENTIAL REACTOR MATERIALS

Edited by C. J. Rodden, Director, New Brunswick Laboratory, U. S. Atomic Energy Commission; contributions from authorities.

(Being written; to be ready for publisher in spring of 1960.)

CRITICAL AND SUBCRITICAL ASSEMBLIES AND THEIR USE IN REACTOR DESIGN

By Dixon Callihan, Oak Ridge National Laboratory; with contributions from W. C. Redman, Argonne National Laboratory; Herbert Kouts, Brookhaven National Laboratory; and E. C. Campbell, Oak Ridge National Laboratory.

(Writing started; to be ready for publisher in fall of 1960.)

FAST BREEDER REACTOR HANDBOOK

By A. Amarosi and others of Atomic Power Development Associates.

(To be ready for publisher in spring of 1961.)

NEUTRON ABSORBER MATERIALS FOR REACTOR CONTROL

By W. K. Anderson, Knolls Atomic Power Laboratory, General Electric Co.; and J. S. Theilacker, Bettis Plant, Westinghouse Electric Corp. (under sponsorship of AEC's Naval Reactors Branch).

(To be ready for publisher in summer of 1959.)

NUCLEAR REACTOR DESIGN MANUAL

Edited by N. J. Palladino and B. F. Langer, Bettis Plant, Westinghouse Electric Corp.; and I. H. Mandil, Naval Reactors Branch, Division of Reactor Development, U. S. Atomic Energy Commission (under sponsorship of AEC's Naval Reactors Branch).

(To be ready for publisher in fall of 1959.)

RADIATION DAMAGE TO REACTOR FUELS

J. P. Howe, Atomics International, and others.

(Being written; to be ready for publisher in summer of 1960.)

REACTOR HANDBOOK (2d Ed.)

Vol. I, Physics and Shielding, edited by H. Soodak, Nuclear Development Corporation of America, and E. P. Blizard, Oak Ridge National Laboratory.

Vol. II, Engineering, edited by S. McLain, Argonne National Laboratory.

Vol. III, Materials, edited by C. R. Tipton, Battelle Memorial Institute.

Vol. IV, Fuel Reprocessing, edited by R. B. Richards, Hanford Atomic Products Division, General Electric Co.

REACTOR HEAT TRANSFER AND FLUID FLOW HANDBOOK

Edited by J. Zerbe, Bettis Plant, Westinghouse Electric Corp. (under sponsorship of AEC's Naval Reactors Branch).

(To be ready for publisher in fall of 1959.)

THERMAL STRESS IN REACTOR DESIGN

By Staff, Franklin Institute.

(Writing in progress; to be ready for publisher in spring of 1960.)

WASTE DISPOSAL

TREATMENT AND DISPOSAL OF HIGH-LEVEL RADIOACTIVE LIQUID WASTES

By E. I. Goodman and H. L. Sturga, Nuclear Science and Engineering Corporation.

(Nearing completion; to be ready for publisher in summer of 1959.)

TREATMENT AND DISPOSAL OF LOW-LEVEL RADIOACTIVE WASTES

By C. P. Straub, Robert A. Taft Sanitary Engineering Center.

(Writing in progress; to be ready for publisher in fall of 1959.)

ATTACHMENT THREE

COUNTRIES RECEIVING UNCLASSIFIED DEPOSITORY LIBRARIES ON AN INFORMATION EXCHANGE BASIS

1. Australia

   Sutherland, Australian Atomic Energy Commission

2. Canada

   Hamilton, Ontario, McMaster University
   Vancouver, University of British Columbia

3. United Kingdom

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   Birmingham, Central Library

   Bristol, Central Library

   Kingston upon Hull, Central Library

   Leeds, Central Library

   Liverpool, Central Library

   London, Central Library; Science Museum Library

   Manchester, Central Library

   Newcastle upon Tyne, Central Library

   Nottingham, Public Libraries

   Sheffield, Central Library

   Northern Ireland

   Belfast, Ministry of Commerce

   Scotland

   Glascow, The Mitchell Library

4. France

   Paris, Academie des Sciences

5. Germany

   Frankfurt/Main, Gmelin Institute

6. Italy

   Milano, Comitato Nazionale per le Ricerche Nucleari

COUNTRIES RECEIVING UNCLASSIFIED ATOMS-FOR-PEACE DEPOSITORY LIBRARIES

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   Buenos Aires, Comision Nacional de Energia Atomica

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   Canberra, Australian National Library

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   Vienna, Institut fur Radiumforschung der Oesterreichischen Akademie der Wissenschaften

   Boltzmanngasse, Institut fur Radiumforschung der Oesterreichischen Akademie der Wissenschaften

4. Belgium

   Brussels, Centre d'Etudes pur les Applications de l'Energie Nucleaire

5. Belgian Congo

   Leopoldville, Lavanium University

6. Brazil

   Rio de Janeiro, Instituto Brasileiro de Bibliografia e Documentacao

7. Burma

   Rangoon, Union of Burma Applied Research Institute

8. Canada

   Ottawa, National Research Council Library

9. Ceylon

   Colombo, University of Ceylon

10. Chile

    Santiago, Ministerio de Relaciones Exteriores

11. Colombia

    Bogota, Instituto Colombiano de Asuntos Nucleares

12. Costa Rica

    San Pedro, University of Costa Rica Library

Countries Receiving Unclassified Atoms-For-Peace Depository Libraries (Con't)

13. Cuba

Havana, Comision de Energia Nuclear de Cuba

14. Denmark

Riso, Atomic Energy Commission Research Establishment

15. Dominican Republic, Ciudad Trujillo, National Palace

16. Ecuador

(Permanent address not established)

17. Egypt

Cairo, Atomic Energy Commission

18. El Savador

(Permanent address not established)

19. Finland

Helsinki, Teknillisen Korkeakoulun Kirjasto

20. France

Gif-sur-Yvette, Centre d'Etudes Nucleaires de Saclay

21. Germany

Berlin, Hahn-Meitner Institut fur Kernforschung

Munich, Technische Hochschule, Bibliothek

22. Ghana

Accra, University College of Ghana

23. Greece

Athens, Greek Atomic Energy Commission

24. Guatemala

Guatemala, Comision Nacional de Energia Nuclear

25. Haiti

Port au Prince, University of Haiti

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Countries Receiving Unclassified Atoms-For-Peace Depository Libraries (Con't)

26. Honduras

(Permanent address not established)

27. Iceland

Reykjavik, University of Iceland, Atomic Energy Library

28. India

Bombay, Department of Atomic Energy

29. Iran

Teheran

30. Iraq

Baghdad, The Ministry of Development, Atomic Energy Division

31. Ireland

Dublin, University College

32. Israel

Tel Aviv, Israel Atomic Energy Commission

33. Italy

Rome, Comitato Nacionale per le Ricerche Nucleari

34. Japan

Tokyo, Science Section, Diet Library

35. Korea

Seoul, Ministry of Education, Atomic Energy Section

36. Lebanon

Beirut, American University

37. Luxembourg, Ministry of Transport and Electricity

38. Mexico

Mexico, D. F., Comision Nacional de Energia Nuclear

39. Netherlands

The Hague, Reactor Centrum Nederland

Countries Receiving Unclassified Atoms-For-Peace Depository Libraries (Con't)

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Wellington, Department of Scientific and Industrial Research

41. Norway

Lillestrom, Institutt for Atomenergi

42. Pakistan

Karachi, Atomic Energy Commission

43. Peru

Lima, Biblioteca Nacional de Peru

44. Philippine Republic

Manila, Interdepartmental Committee on Atomic Energy

45. Poland

Warsaw, Office of the Commissioner for Uses of Nuclear Energy

46. Portugal

Lisbon, Junta de Energia Nuclear

47. Republic of China (Taiwan)

Taiwan, National Tsing Hua University

48. Spain

Madrid, Junta de Energia Nuclear

49. Sweden

Stockholm, Atomenergi AB

50. Switzerland

Zurich, Institut fur Physik, Eidg. Technische Hochschule

51. Thailand

Bangkok, Office of the Thai Atomic Energy Commission

52. Turkey

Ankara, Turkish Atomic Energy Commission

Countries Receiving Unclassified Atoms-For-Peace Depository Libraries (Con't)

53. Union of South Africa

Pretoria, Council for Scientific and Industrial Research

54. Uruguay

Montevideo, Universidad de Montevideo, Instituto de Fisica

55. Venezuela

Caracas, Instituto Venezolano de Neurologia e Investigaciones Cerebr

56. Viet-Nam

(Permanent address not established)

57. Yugoslavia

Belgrade, Federal Commission for Nuclear Energy

INTERNATIONAL ORGANIZATIONS RECEIVING UNCLASSIFIED ATOMS-FOR-PEACE DEPOSITORY LIBRARIES

1. Euratom

Belgium, Brussels, La Bibliotheque Euratom

2. Inter-American Nuclear Energy Commission

Washington, D. C., Pan American Union

3. International Atomic Energy Agency

Austria, Vienna

4. Organization for European Economic Cooperation (OEEC)

France, Paris

5. United Nations

Geneva, Switzerland, United Nations Library

New York, United Nations Headquarters

ATTACHMENT FOUR

EXCERPT FROM TID-4554

EXCHANGE LIST: Organizations Having Publication Exchange Agreements

With the AEC Technical Information Service

Sept. 15, 1959

UNITED STATES ATOMIC ENERGY COMMISSION
Technical Information Service

USAEC FOREIGN EXCHANGE PROGRAM

ORGANIZATION	MATERIAL RECEIVED: SCANNED FOR NUCLEAR SCIENCE ABSTRACTS	MATERIAL RECEIVED: REFERENCE USE ONLY	MATERIAL DEPOSITED AT	DATE OF EXCHANGE AGREEMENT
ALGERIA				
University of Algiers, Faculté des Sciences, Algiers	Publications Scientifiques de l'Université d'Alger Serie B	Publications Scientifiques de l'Université d'Alger Serie A	ORINS	1955
ARGENTINA				
Asociacion Argentian para el Progreso de las Ciencias, Buenos Aires		Ciencia e Investigacion	ORINS	1950
Asociacion Farmaceutica y Bioquimica Argentina, Buenos Aires		Revista Farmaceutica	ORINS	1950
Asociacion Fisica Argentina, Buenos Aires		Revista	ORINS	1950
Asociacion Medica Argentina, Buenos Aires		Revista	ORINS	1950
Asociacion Quimica Argentina, Buenos Aires		Anales Industria y Quimica	ORNL ORINS	1950
Comision de Investigacion Cientifica de la Provincia de Buenos Aires, La Plata	Memoria		ORINS	1950
Comision Nacional de la Energia Atomica, Buenos Aires	Serie Fisica Serie Mathematica Miscelanea Serie Quimica Serie Geology		ORINS ORNL	1953 1953
Direccion General de Industria Minera, Ministerio de Industria y Comercio de la Nacion, Buenos Aires		Anales Boletin Publicacions	ORINS	1950
Facultad de Ciencias Mathematicas, Fisico-Quimicas y Naturales, Universidad Nacional del Litoral, Rosario		Publicaciones Mathematicae Notae	ORINS	1950

ORGANIZATION	MATERIAL RECEIVED: SCANNED FOR NUCLEAR SCIENCE ABSTRACTS	MATERIAL RECEIVED: REFERENCE USE ONLY	MATERIAL DEPOSITED AT	DATE OF EXCHANGE AGREEMENT
Facultad de Quimica y Farmacia Biblioteca, La Plata		Revista de la Facultad de Ciencias Quimicas	ORINS	1950
Instituto Nacional de Investigacion de las Ciencias Naturales, Buenos Aires		Revista: Ciencias Zoologicas Revista: Ciencias Botanicas Revista: Ciencias Geologicas	ORINS	1950
Medicina, Buenos Aires	Medicina		ORINS	1950
Ministerio de Educacion de la Nacion, Observatorio Astronomico de Cordoba, Cordoba		Tiradas Aparte	ORINS	1950
Sociedad Cientifica Argentina, Buenos Aires		Anales	ORINS	1950
Universidad Nacional de La Plata, Facultad de Ciencias Medicas, La Plata		Boletin Biologico	ORINS	1950
Universidad Nacional de La Plata y Museo de La Plata, La Plata		Revista Notas	ORINS	1960
AUSTRALIA				
Australian National Research Council, Sydney		Australian Journal of Science	ORINS	1950
Commonwealth Scientific and Industrial Research Organization, Melbourne	Australian Journal of Agricultural Research Australian Journal of Applied Science Australian Journal of Chemistry Australian Journal of Physics		ORINS	1950
Department of Agriculture, Victoria, Burnley		Journal of Agriculture of the Department of Agriculture, Victoria	ORINS	1951
Department of Agriculture and Stock, Brisbane		Queensland Journal of Agricultural Science	ORINS	1950
Institution of Engineers, Sydney		Journal	ORGDP	1950
Medical Journal of Australia, Glebe	Medical Journal of Australia		ORINS	1950
Public Library of South Australia, Adelaide		South Australia Director of Mines Annual Report South Australia Geological Survey Bulletin South Australia Mining Review	ORINS	1950
Royal Australasian College of Surgeons, Melbourne		Australian and New Zealand Journal of Surgery	ORINS	1950
The Royal Australian Chemical Institute, Melbourne		Journal and Proceedings Reviews of Pure and Applied Chemistry	ORINS	1950

ORGANIZATION	MATERIAL RECEIVED: SCANNED FOR NUCLEAR SCIENCE ABSTRACTS	MATERIAL RECEIVED: REFERENCE USE ONLY	MATERIAL DEPOSITED AT	DATE OF EXCHANGE AGREEMENT
Royal Society of New South Wales, Sydney		Journal and Proceedings	ORINS	1950
University of Adelaide, Barr Smith Library, Adelaide		Australian Journal of Experimental Biology and Medical Science	ORINS	1950
University of Sydney, School of Physics, Sydney, New South Wales		Nucleus	TISE	1959
AUSTRIA				
Institut fur Radiumforschung der Osterr. Akademie der Wissenschaften, Vienna	Mitteilungen des Institutes fur Radiumforschung		ORINS	1951
Zentralanstalt fur Meteorologie und Geodynamik, Vienna		Papers and publications	ORINS	1957
BELGIAN CONGO				
Service Geologique, Leopoldville		Bulletin	TISE	1957
BELGIUM				
Académie Royale de Belgique, Brussels	Bulletins, Memoires, and Annuaires		ORINS	1950
Acta Clinica Belgica, Brussels		Acta Clinica Belgica	ORINS	1950
Association Belge Pour le Developpement Pacifique de l'Energie Atomique A.S.B.L., Brussels	Information Bulletin		ORINS	1958
Bruxelles–Medical, Brussels		Bruxelles–Medical	ORINS	1950
Centre de Physique Nucléaire de l' Universitć Libre de Bruxelles, Brussels	Reports		ORINS	1950
Fedération des Industries Chimiques de Belgique, Brussels	Industrie Chimique Belge		ORINS	1957
Institut Royal des Sciences Naturelles de Belgique, Brussels		Bulletin	ORINS	1950
Koninklijke Vlaamse Academie Voor Wetenschappen, Letteren en Schone Kunsten van Belgie, Brussels		Mededelingen Verhandelingen	ORINS	1951
Révue Medicale de Liege, Liege		Revue Medicale de Liege	ORINS	1950
Société Belge de Géologie, de Paléontologie, et d'Hydrologie, Brussels		Bulletin	ORINS	1951

ORGANIZATION	MATERIAL RECEIVED: SCANNED FOR NUCLEAR SCIENCE ABSTRACTS	MATERIAL RECEIVED: REFERENCE USE ONLY	MATERIAL DEPOSITED AT	DATE OF EXCHANGE AGREEMENT
Société Chimique de Belgique, Brussels		Bulletin	ORINS	1950
Societe Royale des Sciences de Liege, Liege		Bulletin Memoris	ORINS	1950
Société Scientifique de Bretagne, Louvain		Bulletin	ORINS	1950
Vlaamse Chemische Vereniging, Brussels		Mededelingen	ORINS	1951
Vlaamse Ingenieursvereniging, Antwerp		Technisch Wetenschappelijk Tidschrift	ORINS	1951
BOLIVIA				
Sociedad Internacional de Investigaciones Cientificas, Cochabamba		O Hospital	ORINS	1950
BRAZIL				
Academia Brasileira de Ciencias, Rio de Janeiro	Anais		ORINS ORNL	1950
Anais Paulistas de Medicina e Cirurgia, Sao Paulo		Anais Paulistas de Medicina e Cirurgia	ORINS	1950
Divisao do Instituto de Higiene, Minas Gerais		Arquivos	ORINS	1950
Faculdade de Medicina do Universidade de Sao Paulo, Sao Paulo		Anais Folia Clinica et Biologica Revista de Biologia e Higiene Revista do Hospital das Clinicas Revista de Medicina	ORINS	1950
Instituto Adolfo Lutz, Sao Paulo		Revista do Instituto, Adolfo Lutz	ORINS	1950
Instituto Biologico, Sao Paulo		Arquivos	ORINS	1950
Instituto Brasileiro de Bibliografia e Documentacao, Rio de Janeiro		Technical Reports	ORINS	1952
Instituto de Matematica Pura e Aplicada, Rio de Janeiro		Summa Brasiliensis Mathematicae	ORINS	1951
Instituto de Pesquisas Tecnologicas, Sao Paulo		Boletim	ORINS	1950
Medicina Cirurgia Farmacia, Rio de Janeiro		Medicina Cirurgia Farmacia	ORINS	1950
Revista Brasileira de Quimica, Sao Paulo		Revista Brasileira de Quimica	ORINS	1955
Revista Cientifica, Rio de Janeiro		Revista Cientifica	ORINS	1951
CANADA				
Department of Agriculture, Ottawa, Ontario		Canadian Journal of Agricultural Science	ORINS	1950

ORGANIZATION	MATERIAL RECEIVED: SCANNED FOR NUCLEAR SCIENCE ABSTRACTS	MATERIAL RECEIVED: REFERENCE USE ONLY	MATERIAL DEPOSITED AT	DATE OF EXCHANGE AGREEMENT
Department of Mines and Technical Surveys, Mines Branch, Ottawa, Ontario		Reports	TISE	1950
Department of Veterans Affairs, Ottawa, Ontario		Treatment Services Bulletin	ORINS	1950
Engineering Institute of Canada, Montreal, Quebec		The Engineering Journal	ORINS	1949
Geological Survey of Canada, Ottawa, Ontario		Geological Survey of Canada	ORINS	1951
Laval University, Faculty of Medicine, Quebec		Laval Medical	ORINS	1950
Manitoba Chamber of Mines, Winnipeg, Manitoba		The Precambrian	ORNL	1950
Research Council of Alberta, Edmonton, Alberta		Annual Reports	ORINS	1950
Revue Canadienne de Biologie, Montreal, Quebec		Revue Canadienne de Biologie	ORINS	1949
University of Alberta Library, Edmonton, Alberta		Scientific Reports	TISE	1950
CHILE				
Sociedad Nacional de Mineria, Santiago		Boletin Minero	ORINS	1950
CZECHOSLOVAKIA				
Central Engineering Library of Czechoslovakia, Prague	Jaderna Energie		ORINS	1957
Czechoslovak Academy of Science, Institute of Applied Physics, Prague	Czechoslovak Journal of Physics		ORINS	1950
Czechoslovak Academy of Science, Institute of Biology, Prague	Folia Biologica		ORINS	1950
Czechoslovak Academy of Science, Zakladni Knihovna, Prague	Collections of Czechoslovak Chemical Communications		ORINS	1950
Institute of Industrial Hygiene and Occupational Diseases, Bratislava	Jaderna Energia Pracovní Lekarstvi		ORINS	1950
Statni Vyzkumny Ustav Materialu a Technologie, Prague	Materialovy Sbornik		ORINS	1950
DENMARK				
Carlsberg Laboratorium, Copenhagen		Comptes Rendus des Travaux du Laboratoire Carlsberg	ORINS	1950

ORGANIZATION	MATERIAL RECEIVED: SCANNED FOR NUCLEAR SCIENCE ABSTRACTS	MATERIAL RECEIVED: REFERENCE USE ONLY	MATERIAL DEPOSITED AT	DATE OF EXCHANGE AGREEMENT
Danish Association for Industrial Development of Atomic Energy, Danish Academy of ATV Technical Sciences, Hellerup		Reports	TISE	1959
Institut Danois des Echanges, Copenhagen		Ingeniorvidenskabelige Skrifter Transactions of the Academy of the Technical Sciences Bibliografisk Fortegnelse	ORINS	1950
Kongelige Danske Videnskabernes, Selskab, Copenhagen	Mathematisk-fysiske Meddelelser Mathematisk-fysiske Skrifter		ORINS	1949
University of Copenhagen Library, Copenhagen	Acta Chemica Scandinavica	Acta Physiologica Scandinavica Index Medicus Danicus Danish Medical Bulletin	ORINS	1951
EGYPT				
Egyptian Academy of Sciences, Cairo		Proceedings	ORINS	1951
Mathematical and Physical Society of Egypt, Faculty of Science, Cairo		Proceedings	ORINS	1950
EIRE				
Medical Association of Eire, Dublin		Journal	ORINS	1950
Royal Dublin Society, Dublin	Scientific and Economic Proceedings		ORINS	1950
Royal Irish Academy, Dublin		Proceedings of the Royal Irish Academy	ORINS	1950
School of Cosmic Physics, Dublin Institute for Advanced Studies, Dublin	Communications		ORINS	1950
FINLAND				
Abo Akademie Bibliotek, Abo		Acta Academiae Aboensis Mathematica et Physica	ORNL	1953
Geologinen Tutkimuslaitos, Helsinki		Bulletin	ORNL	1950
Societas Medicorum Fennica, Helsinki		Annales Medicinae Internae Fenniae Annales Medicinae Experimentalis et Biologiae Fenniae	ORINS	1951
Suomalainen Tiedeakatemia Library, Helsinki		Annales	ORINS	1950
Suomalaisten Kemistien Seura, Helsinki		Suomen Kemistilehti	ORNL	1951

ORGANIZATION	MATERIAL RECEIVED: SCANNED FOR NUCLEAR SCIENCE ABSTRACTS	MATERIAL RECEIVED: REFERENCE USE ONLY	MATERIAL DEPOSITED AT	DATE OF EXCHANGE AGREEMENT
FRANCE				
	Symposiums		ORINS	1959
A.T.E.N., Paris	A.T.E.N., Bulletin		TISE	1959
Commissariat à l'Energie Atomique, Saclay	CEA Reports		TISE	1953
Institut de France, Académie des Sciences, Paris	Comptes rendus		ORINS	1950
Institut Henri Poincaré, Paris		Annales de l'Institut	ORINS	1952
Institut Pasteur, Paris		Annales de l'Institut Pasteur	ORNL	1951
Institut Polytechnique, Grenoble		Annales de l'Institut Fourier	ORINS	1951
Revue de l'Aluminium, Paris		Revue de l'Aluminium	ORNL	1953
Revue de Pathologie Générale et Comparée, Paris		Revue de Pathologie	ORINS	1950
Service Central des Echanges de Documents, Paris	Chimie et Industrie Chimie Analytique Produits Pharmaceutiques Energie Nucleaire		ORINS ORINS ORNL ORINS	1949
Société Francaise des Ingenieurs Techniciens du Vide, Paris		Le Vide	ORINS	1950
Société Francaise de Mineralogie et de Cristallographie, Paris		Bulletin	ORINS	1951
Société Mathematique de France, Paris		Bulletin de la Société Mathematique de France	ORINS	1951
Société Scientifique de Bretagne, Rennes		Bulletin	ORINS	1950
United Nations Educational and Scientific Cultural Organization, Paris		Monthly Bulletin	ORINS	1958
University of Strasbourg, Strasbourg		Theses	TISE	1959
Université de Toulouse, Toulouse		Annales de la Faculté des Sciences de Toulouse	ORINS	1950
GERMANY				
AEG Mitteilungen, Berlin	AEG-Mitteilungen		ORINS	1958
Aerztliche Forschung, Bad Worishofen		Aerztliche Forschung	ORINS	1950
Akademie der Wissenschaften, Göttingen		Nachrichten der Akademie der Wissenschaften in Göttingen	ORINS	1950
Angewandte Chemie, Heidelberg	Angewandte Chemie		ORINS	1951
Archiv fur Technisches Messen, Munich	ATM-Archiv fur Technisches Messen		ORINS	1950

ORGANIZATION	MATERIAL RECEIVED: SCANNED FOR NUCLEAR SCIENCE ABSTRACTS	MATERIAL RECEIVED: REFERENCE USE ONLY	MATERIAL DEPOSITED AT	DATE OF EXCHANGE AGREEMENT
Atombrief, Regensburg	Atombrief		ORINS	1957
Atomkern-Energie, Heidenheim/Brens	Atomkern-Energie		ORINS	1958
Atompraxis, G. Braun, Karlsruhe	Atompraxis		ORINS	1958
Bayerischen Akademie der Wissenschaften, Munich		Abhandlungen	ORINS	1950
Bundesminister fur Atomkernenergie und Wasserwirtschaft, Bad Godesburg		Atom und Wasser	TISE	1959
Der Deutscher Wetterdienst, Offenbach am Main		Jahresberichte des Deutschen Wetterdienstes	TISE	1959
Deutsches Elektronen-Synchrotron, Hamburg		Desy Reports	TISE	1959
Deutsche Gesellschaft fur Metallkunde, e.V., Stuttgart	Zeitschrift Fur Metallkunde		ORINS	1959
Experimentelle Technik der Physik, Berlin	Experimentelle Technik der Physik		ORINS	1958
Georg Thieme Verlag, Stuttgart		Deutsche Medizinische Wochenschrift	ORINS	1950
Gesellschaft zur Beforderung der gesamten Naturwissenschaften zu Marburg, Marburg	Sitzungsberichte		ORINS	1957
Gesellshaft zur Forderung der Kernphysikalischen Forschung, e.V., Dusseldorf		Research and Development Reports	TISE	1959
Gmelin Institute, Frankfurt (Main)	German reports		TISE	1958
Hahn-Meitner-Institute fur Kernforschung, Berlin	Kernenergi		ORINS	1959
Institut fur Technische Kernphysik der Technischen Hochschule Darmstadt, Darmstadt	These and Dissertations		TISE	1958
KERNREAKTOR, Karlsruhe	Reports		TISE	1957
Laboratorium fur Technische Physik der Technischen Hochschule München, München	Reprints		ORINS	1953
Lehrstuhl fur physikalische Grundlagen der Reaktorwerkstoffe, Aachen	Preprints and Monographs		TISE	1958
Max Planck-Institut für Biophysik, Frankfurt		Reprints	ORINS	1950
Max Planck-Institut für Chemie, Mainz		Reprints	ORINS	1950
Munchener Medizinische Wochenschrift, Munich		Munchener Medizinische Wochenschrift	ORINS	1950

ORGANIZATION	MATERIAL RECEIVED: SCANNED FOR NUCLEAR SCIENCE ABSTRACTS	MATERIAL RECEIVED: REFERENCE USE ONLY	MATERIAL DEPOSITED AT	DATE OF EXCHANGE AGREEMENT
Physikalischen Instituts der Universitat Marburg, Marburg		Reprints	ORINS	1950
Physikalisches Institut der Justus-Liebig-Hochschule, Giessen		Reprints	ORINS	1950
Physikalisches Institut der Technischen Hochschule Munich		Reprints	ORINS	1950
Physikalisches Institut der Universität Frankfurt a.M., Frankfurt		Reprints	ORINS	1950
Physikalisches Institut der Universitat Freiburg, Freiburg		Reprints	ORINS	1950
Physikalisches Institut der Universitat Tubingen, Tubingen		Reprints	ORINS	1950
Physikalisches Institut der Universitat Wurzburg, Wurzburg		Reprints	ORINS	1950
B. G. Teubner Verlagsgesellschaft M. G. H., Stuttgart	Kerntechnik		ORINS	1958
UMSCHAU, Frankfurt		UMSCHAU	ORINS	1950
University of Marburg, Marburg		Sitzungsberichte	ORINS	1957
VDI-Verlag, GMBH, Dusseldorf	Brennstoff-Warme-Kraft		ORINS	1958
VEB verlag Technik, Berlin	Chemische Technik		ORINS	1959
Zeitschrift fur Naturforschung, Tubingen	Zeitschrift fur Naturforschung, Pt. A Zeitschrift fur Naturforschung, Pt. B.		ORINS	1950
GREAT BRITAIN				
Analyst and Analytical Abstracts, London	Analytical Abstracts Analyst		ORINS	1958
Atom Industry, London		Atom Industry	TISE	1958
Birmingham Medical Institute, Birmingham		Birmingham Medical Review	ORINS	1956
Birmingham Metallurgical Society, Norfield, Birmingham		Journal of the Birmingham Metallurgical Society	ORINS	1950
British Ceramic Research Association, Stoke-on-Trent		British Ceramic Abstracts	ORINS	1950
British Council, London		British Medical Bulletin	ORINS	1950
British Electrical and Allied Manufacturers' Association, Inc., London		Beama Journal	ORINS	1950

ORGANIZATION	MATERIAL RECEIVED: SCANNED FOR NUCLEAR SCIENCE ABSTRACTS	MATERIAL RECEIVED: REFERENCE USE ONLY	MATERIAL DEPOSITED AT	DATE OF EXCHANGE AGREEMENT
British Empire Cancer Campaign, London		Annual Report	ORINS	1950
British Institution of Radio Engineers, London		Journal	ORINS	1949
British Interplanetary Society, London	Journal		ORINS	1950
British Medical Association, London		British Medical Journal	ORINS	1950
British Scientific Instrument Research Association, Kent		Bulletin	ORGDP	1950
Butterworths and Company, Ltd., London		British Journal of Physical Medicine	ORINS	1950
Cambridge Philosophical Society, Cambridge		Proceedings	ORINS	1950
Cambridge University Medical Society, Cambridge		Cambridge University Medical Society Magazine	ORINS	1951
Commonwealth Bureau of Plant Breeding and Genetics, Cambridge		Plant Breeding Abstracts	ORINS	1950
Department of Scientific and Industrial Research, London		Journal	ORINS	1950
		Water Pollution Abstracts	ORNL	
		Fuel Abstracts	ORNL	
Engineer, London		The Engineer	ORGDP	1950
Engineers' Digest, London		The Engineers' Digest	ORGDP	1950
Federation of British Industries, Nuclear Energy Committee, London		Conference Papers	TISE	1950
General Electric Company, Limited, Erith, Kent	Atomic Energy Review Electrical Review		ORINS	1956
Guy's Hospital Medical School, London Bridge		Guy's Hospital Reports	ORINS	1950
Heywood Company, Ltd., London	British Chemical Engineering		ORINS	1959
Imperial Chemical Industries Limited, Birmingham		Titanium Abstract Bulletin	ORINS	1950
Imperial College of Science and Technology, London		Journal of the Royal College of Science	ORINS	1950
Institute of Marine Engineers, London	Journal of the Joint Panel on Nuclear Marine Propulsion		ORINS	1958
The Institute of Welding, London	British Welding Journal		ORINS	1959
Institution of Electrical Engineers, London		Science Abstracts	ORINS	1950
Institution of Mining and Metallurgy, London		Bulletin and I.M.M. Abstracts	ORNL	1950
Low Temperature Research Station, Cambridge	Reprints		TISE	1950

ORGANIZATION	MATERIAL RECEIVED: SCANNED FOR NUCLEAR SCIENCE ABSTRACTS	MATERIAL RECEIVED: REFERENCE USE ONLY	MATERIAL DEPOSITED AT	DATE OF EXCHANGE AGREEMENT
Marine Biological Association of the United Kingdom, Plymouth		Journal	ORINS	1950
I. R. Maxwell and Company, Ltd., London	Astronautica Acta		ORINS	1958
Medical Press, London		The Medical Press	ORINS	1950
Mullard Radio Valve Company, Ltd., Redhill, Surrey		Phillips Research Reports Phillips Technical Review	ORINS	1950
Pharmaceutical Society, London		Journal of Pharmacy and Pharmacology	ORINS	1950
Physical Society, London	British Journal of Applied Physics		ORINS	1950
Princes Press, London	Nuclear Energy Engineer		ORINS	1959
Research Association of British Paint, Colour, and Varnish Manufacturers, Teddington, Middlesex		Review of Current Literature	ORINS	1950
Research Laboratories, General Electric Company, Ltd., Wembley		Communications G.E.C. Journal	ORINS	1951
Road Research Laboratory, Middlesex		Journal	ORINS	1950
Royal Institute of Public Health and Hygiene, London		Journal	ORINS	1950
Royal Society of Medicine, London		Proceedings	ORINS	1949
Science Museum, Science Library, London		Weekly Lists of Accessions	ORINS	1950
Strangeways Research Laboratory, Cambridge		Reprints	ORINS	1950
University College, International Union of Crystallography, Cardiff	Acta Crystallographica		ORINS	1950
University College of the South West of England, The Washington Singer Laboratories, Exeter		Reprints	ORINS	1950
University of Durham Philosophical Society, Durham		Proceedings	ORINS	1950
Weekly Science Newsletter Ltd., London		Science To-Day	ORINS	1950
Wellcome Research Laboratories, Kent		Reprints	ORINS	1949
GREECE				
University of Athens, Department of Clinical Therapeutics, School of Medicine, Athens		Reprints	ORINS	1959

ORGANIZATION	MATERIAL RECEIVED: SCANNED FOR NUCLEAR SCIENCE ABSTRACTS	MATERIAL RECEIVED: REFERENCE USE ONLY	MATERIAL DEPOSITED AT	DATE OF EXCHANGE AGREEMENT
		HUNGARY		
Energiagazdalkodasi Tudomanyos Egyesulet, Budapest	Energia es Atomtechnika		ORINS	1959
Magyar Tudomanyos Akademia Konyvtara, Bibliotheca Academiae Scientiarum Hungaricae, Budapest	Acta Physica		ORINS	1958
Periodica Polytechnica, Budapest	Periodica Polytechnica (Chemical Engineering) (Electrical Engineering) (Engineering)		ORINS	1958
Research Institute for Agrochemistry and Soil Science, Budapest	Reprints		ORINS	1959
		INDIA		
Bose Research Institute, Calcutta	Transactions		ORINS	1950
Calcutta Mathematical Society, Calcutta		Bulletin for Libraries	ORINS	1950
Calcutta Medical Journal, Calcutta		Calcutta Medical Journal	ORINS	1950
Council of Scientific and Industrial Research, New Delhi	Journal		ORINS	1950
Current Science Association, Bangalore		Current Science	ORINS	1950
Indian Academy of Sciences, Bangalore	Proceedings, Section A		ORINS	1950
Indian Association for the Cultivation of Science, Calcutta	Indian Journal of Physics Proceedings of the Indian Association for the Cultivation of Science		ORINS	1950
Indian Ceramic Society, Benares		Transactions	ORINS	1951
Indian Chemical Society, Calcutta	Journal		ORINS	1950
Indian Institute of Science Library, Bangalore	Journal		ORINS	1950
Indian Journal of Radiology, Bombay	Indian Journal of Radiology		ORINS	1950
Indian Science News Association, Calcutta		Science and Culture	ORINS	1950
Institute of Nuclear Physics, Calcutta		Reprints	ORINS	1950
National Chemical Laboratory of India, Poona	Journal of Scientific and Industrial Research, Section A Journal of Scientific and Industrial Research, Section B Journal of Scientific and Industrial Research, Section C		ORINS	1950

ORGANIZATION	MATERIAL RECEIVED: SCANNED FOR NUCLEAR SCIENCE ABSTRACTS	MATERIAL RECEIVED: REFERENCE USE ONLY	MATERIAL DEPOSITED AT	DATE OF EXCHANGE AGREEMENT
National Institute of Sciences of India, New Delhi	Proceedings, Section B	Transactions	ORINS	1950
Parliament Library, New Delhi		Atomic News Digest	ORINS	1958
School of Tropical Medicine, Calcutta		Bulletin	ORINS	1958
Tata Institute of Fundamental Research, Bombay		Reprints, lectures, and symposiums	ORINS	1950
University of Bombay, Bombay		Journal	ORINS	1961
IRAQ				
Royal Faculty of Medicine, Baghdad		Journal of the Faculty of Medicine	ORINS	1950
ISRAEL				
Independent Biological Laboratories, Ramatayim		Bulletin	ORINS	1950
Jewish National and University Library, Jerusalem	Bulletin of the Research Council of Israel, Section A Bulletin of the Research Council of Israel, Section B Bulletin of the Research Council of Israel, Section C		ORINS	1952
Jewish National and University Library, Jerusalem (Cont'd.)	Bulletin of the Research Council of Israel, Section D Bulletin of the Research Council of Israel, Section E Bulletin of the Research Council of Israel, Section F			
Research Council of Israel, Rehovot	Bulletin, Section A Bulletin, Section B Bulletin, Section C Bulletin, Section D Bulletin, Section E Bulletin, Section F		ORINS	1950
ITALY				
Academia Ligure di Science e Letters, Genoa		Atti	ORINS	1950
Academia Nazionale dei Lincei, Rome		Rendiconti Fisica Rendiconti della Classe di Scienze Fisiche Mathematiche e Naturali	ORINS	1950

ORGANIZATION	MATERIAL RECEIVED: SCANNED FOR NUCLEAR SCIENCE ABSTRACTS	MATERIAL RECEIVED: REFERENCE USE ONLY	MATERIAL DEPOSITED AT	DATE OF EXCHANGE AGREEMENT
Associazione Italiana di Metallurgia, Milan		La Metallurgia Italiana	ORINS	1955
Atomo e Industria, Rome	Atomo e Industria		ORINS	1959
Biblioteca Centrale Politecnico Milano, Milan		Pubblicazioni del Politecnico di Milano	ORINS	1950
Biblioteca Governativa e Libreria Civica, Cremona		Bollettino della Societa Medico- Chirurgica Annali	ORINS	1949
Centro Informazioni Studi Esperienze, Milan	Reports Energia Nucleare		TISE ORINS	1950
Centro di Studio per la Fisica delle Microonde Firenze		Reprints	ORINS	1950
Chimica e l'Industria, Milan		Chimica e l'Industria	ORINS	1950
Consiglio Nazionale delle Ricerche, Rome	La Ricerca Scientifica		ORINS	1951
Giornale di Clinica Medica, Parma		Gio. di Clinica Medica	ORINS	1950
Gruppo Giornalistico Minerva Medica, Torino	Archivio per le Scienze Mediche		ORINS	1951
Institute of Pharmacology, University of Milan, Milan	Giornale Italiano di Chemioterapia		ORINS	1950
Istituto di Biologia Generale, Universita di Perugia, Perugia		Revista di Biologia	ORINS	1950
Istituto di Chimica Farmaceutica, Rome		Il Farmaco Edizione Scientifica	ORINS	1950
Istituto Chimico "G. Ciamician," dell'Universita di Bologna, Bologna		Bollettino Scientifico	ORINS	1950
Istituto di Fisica "Guglielmo Marconi," Rome	Nuovo Cimento		ORINS	1950
Istituto di Fisica, dell'Universita di Ferrara, Ferrara		Annali	ORINS	1950
Istituto Mathematico, Universita di Modena, Modena		Atti	ORINS	1950
Istituto Nazionale di Geofisica, Rome		Annali	ORINS	1950
Istitto Nazionale di alta Mathematica, Rome		Rendiconti di Mathematica e delle sue Applicazioni	ORINS	1950
Istituto Nazionale di Ottica, Florence		Atti della Fondazione Giorgio Ronchi	ORINS	1950
Istituto Nazionale per lo Studi e la Cura dei Tumori, Milan		Tumori	ORINS	1950
Istituto Nazionale di Ultracustica "O. M. Corbino," Rome		Reprints	ORINS	1950
Istituto di Pathologia Generale, Florence		Lo Sperimentale	ORINS	1950

ORGANIZATION	MATERIAL RECEIVED: SCANNED FOR NUCLEAR SCIENCE ABSTRACTS	MATERIAL RECEIVED: REFERENCE USE ONLY	MATERIAL DEPOSITED AT	DATE OF EXCHANGE AGREEMENT
Istituto Sperimentale dei Mettali Leggeri, Milan		Alluminio	ORINS	1957
Istituto Superiore di Sanita, Rome		Rendiconti	ORINS	1950
Istituto Veneto di Scienze, Lettere ed Arti, Venice		Atti	ORINS	1950
Laboratori di Fisiologia e di Chimica Biologica, Milan		Bollettino della Societa Italiana di Biologia Sperimentale Archivio di Scienze Biologiche	ORINS	1950
Scientia Medica Italica, Rome		Scientia Medica Italica	ORINS	1950
Seminario Mathematico e Fisico di Milano, Milan	Rendiconti		ORINS	1950
Societa Italiana di Biologia Sperimentale, Naples		Bollettino	ORINS	1950
Societa Italiana di Fisica, Milan	Nuovo Cimento		ORINS	1950
Tecnindustria Editrice, Rome		Rassegna Chimica	ORINS	1950
Universita degli Studi di Bologna, Facolta di Ingegneria, Bologna		Publications	ORINS	1950
Universita Degli Studi di Perugia, Perugia		Lavori dell'Istituto di Anatomia Pathologica dell'Universita di Perugia	ORINS	1950
University of Messina, Messina		Radiobiologica Latina	ORINS	1950
JAPAN				
Chemical Society of Japan, Tokyo	Bulletin		ORINS	1950
The College of General Education, University of Tokyo, Tokyo	Scientific Papers		ORINS	1950
Editorial Office, The 2nd Tokyo National Hospital, Tokyo		IRYO	ORNL	1951
Electrotechnical Laboratory, Tokyo	Bulletin		ORINS	1950
Faculty of Medicine, Kyoto University, Kyoto		Acta Scholae Medicinalis	ORINS	1951
Faculty of Science, Hiroshima University, Hiroshima		Journal of Science of the Hiroshima University	ORINS	1955
Fukushima Medical College, Fukushima	Fukushima Journal of Medical Science		ORINS	1950
Gunma University School of Medicine, Maebashi		The Gunma Journal of Medical Sciences	ORINS	1955
Hirosaki University, Hirosaki		Hirosaki Medical Journal	ORNL	1955

ORGANIZATION	MATERIAL SCANNED: SCANNED FOR NUCLEAR SCIENCE ABSTRACTS	MATERIAL SCANNED: REFERENCE USE ONLY	MATERIAL DEPOSITED AT	DATE OF EXCHANGE AGREEMENT
Hiroshima University School of Medicine, Hiroshima		Hiroshima Journal of Medical Science	ORINS	1955
Institute of Physical and Chemical Research, Tokyo	Progress of Theoretical Physics Journal of the Scientific Research Institute		ORINS	1950
Institute for Infectious Diseases, Tokyo University, Tokyo		Japanese Journal of Experimental Medicine	ORNL	1955
Institute for Nuclear Study, University of Tokyo, Tokyo	I N S J		ORINS	1958
IRYO DOKOKAI, Medical Affairs Bureau, Tokyo		IRYO	ORNL	1955
Japan Atomic Energy Research Institute, Nakagun		JAERI Reports	TISE	1959
Japan Atomic Industrial Forum, Inc., Tokyo	Atoms in Japan		ORINS	1957
Japan Meteorological Agency, Tokyo	Bulletin of Atmospheric Radioactivity		ORINS	1957
Keio University, School of Medicine, Tokyo	Keio Journal of Medicine		ORINS	1958
Kyoto University, Institute for Chemical Research, Osaka		Bulletin	ORINS	1959
Mt. Hakkada Botanical Laboratory, Biological Institute, Sendai		Ecological Review	ORNL	1956
Nagoya Imperial University, Nagoya		Nagoya Journal of Medical Science	ORINS	1950
Nagoya University, Mathematical Institute, Nagoya		Nagoya Mathematical Journal	ORINS	1950
National Safety Medical Association, Tokyo		Japanese Safety Forces Medical Journal	ORNL	1955
Osaka University Medical School, Osaka		Medical Journal of Osaka University	ORINS	1950
Physical Institute, Fukuoka	Memoirs of the Faculty of Science Kyushu University, Serie B	Memoirs of the Faculty of Science Kyushu University, Serie A	ORINS	1951
Physical Society of Japan, Tokyo	Journal		ORINS	1950
Science Council of Japan, Tokyo	Japanese Journal of Mathematics Japanese Journal of Geophysics		ORNL ORINS ORINS	1958
Scientific Research Institute, Tokyo	Progress of Theoretical Physics Journal of the Scientific Research Institute		ORINS	1950
Shinshu University Library, Medical Branch, Matsumoto City	Medical Journal		ORINS	1959
Tohoku University, Medical Library, Sendai		Tohoku Journal of Experimental Medicine	ORINS	1950

ORGANIZATION	MATERIAL RECEIVED: SCANNED FOR NUCLEAR SCIENCE ABSTRACTS	MATERIAL RECEIVED: REFERENCE USE ONLY	MATERIAL DEPOSITED AT	DATE OF EXCHANGE AGREEMENT
Tokushima University, School of Medicine, Shikoku	Tokushima Journal of Experimental Medicine		ORINS	1951
University of Kyoto, College of Science, Kyoto		Memoirs	ORINS	1950
University of Kyoto, Library, Kyoto		Acta Scholae Medicinalis Universitatis	ORINS	1951
Yokohama University School of Medicine, Yokohama		Yokohama Medical Bulletin	ORINS	1951
MEXICO				
Escuela Nacional de Ciencias Biologicas, Mexico City		Anales de la Escuela Nacional de Ciencias Biologicas	ORINS	1950
Instituto de Estudios Medicos y Biologicos, Mexico City		Boletin	ORINS	1950
Revista Mexicana de Fisica, Mexico	Revista Mexicana de Fisica		ORINS	1953
Revista Mexicana de Radiologia, Mexico	Revista Mexicana de Radiologia		ORINS	1954
Sociedad Mexicana de Geografia y Estadistica, Mexico City		Boletino	ORINS	1950
NETHERLANDS				
Bibliotheek der Rijksuniversiteit te Leiden, Leiden		Reprints	ORINS	1960
Elsevier Publishing Company, Amsterdam	Journal of the Less-Common Metals		ORINS	1959
F.O.M. Instituut voor Plasma-Fysica, Rijnhuizen, Jutphaas	Laboratory Reports and Publications		ORINS	1959
Institute for Nuclear Research, Zeeman Laboratorium, Amsterdam		Reprints	ORINS	1953
Institute for Theoretical Physics, University of Utrecht, Utrecht		Reprints and Dissertations	ORINS	1950
Koninklijk Instituut van Ingenieurs, s'Gravenhage		Voordrachten	ORINS	1950
Koninklijke Nederlandsche Akademie van Wetenschappen, Amsterdam		Verhandelingen der Afd. Natuurkunde	ORINS	1950
Mathematisch Centrum, Amsterdam		Indagationes Mathematicae	ORINS	1950
Municipal University of Amsterdam, Amsterdam		Dissertations	TISE	1959
Natuurkundig Laboratorium der Rijks-Universiteit, Groningen		Dissertations	ORINS	1958

ORGANIZATION	MATERIAL RECEIVED: SCANNED FOR NUCLEAR SCIENCE ABSTRACTS	MATERIAL RECEIVED: REFERENCE USE ONLY	MATERIAL DEPOSITED AT	DATE OF EXCHANGE AGREEMENT
Natuurkundig Laboratorium der Vrije Universiteit Amsterdam, Amsterdam		Reprints	ORINS	1954
Nederlandsche Natuurkundige Vereeniging, Utrecht		Nederlands Tydschrift voor Natuurkunde	ORINS	1950
Nederlandse Chemische Vereniging, 's-Gravenhage		Recueil des Travaux Chimiques des Pays-Bas	ORINS	1950
Reactor Centrum Nederland, 's-Gravenhage	R.C.N. Bulletin Atoomenergi in Haar Toeparsinger		ORINS	1957
Technische Hogeschool, Delft	Thesis		ORINS	1950
NEW ZEALAND				
British Medical Association, New Zealand Branch, Wellington		New Zealand Medical Journal	ORINS	1950
Department of Scientific and Industrial Research, Wellington		New Zealand Journal of Agricultural Research New Zealand Journal of Geology and Geophysics New Zealand Journal of Science	ORNL	1950
Royal Society of New Zealand, Wellington		Transactions	ORNL	1950
NORWAY				
Faculty of Mathematics and Sciences, University of Oslo, Oslo		Archiv for Mathematik og Naturvidenskab	ORINS	1950
Forsvarets Forskningsinstitutt, Lillestrom	Reports		TISE	1950
Institutt for Teoretisk Astrofysikk, Oslo		Astrophysica Norvegica	ORINS	1951
Joint Establishment for Nuclear Energy Research, Lillestrom	JENER Reports		TISE	1953
Kongelige Norske Videnskabers Selskabs, Trondheim	Forhandlinger	Skrifter	ORINS	1950
Norges Landbrukshogskoles Bibliotek, Vollebekk		Scientific Reports from the Agricultural College of Norway	ORINS	1951
Norsk Geologisk Forening, Mineralogisk-Geologisk Museum, Oslo		Norsk Geologisk Tidsskrift	ORINS	1950
Norsk Hydro's Institute for Cancer Research, The Norwegian Radium Hospital, Oslo	Annual Reports, Reprints		TISE	1958
Universitetsbiblioteket I Bergen, Bergen		Arbok	ORINS	1950

ORGANIZATION	MATERIAL RECEIVED: SCANNED FOR NUCLEAR SCIENCE ABSTRACTS	MATERIAL RECEIVED: REFERENCE USE ONLY	MATERIAL DEPOSITED AT	DATE OF EXCHANGE AGREEMENT
PERU				
Junta de Control de Energia Atomica, Lima		Boletin de Informaciones	ORINS	1958
Sociedad Quimica del Peru, Lima		Boletin	ORINS	1950
POLAND				
Division of Information Services, Office, Commissioner of the Polish Government for the Uses of Nuclear Energy, Warsaw	Postepy Fizyki		TISE	1959
Instytut Badan Jadrowych, Warsaw	Preprints		TISE	1958
Panstwowe Wydawnictwo Naukowe, Warsaw	Nukleonika		ORINS	1957
Polska Akademia Nauk, Polish Academy of Sciences	Acta Physica Polonica Bulletin de l'Academie Polonaise des Sciences Classe III Bulletin de l'Academie Polonaise des Sciences Classe IV		ORINS	1958
PORTUGAL				
Estacao Agronomica Nacional, Sacavem		Agronomia Lusitana	ORINS	1950
Gazeta de Mathematico, Lisbon		Gazeta de Mathematico	ORINS	1951
Instituto Pasteur de Lisboa, Lisbon		Cadernos Cientificos	ORINS	1950
Instituto Portugues de Oncologia, Lisbon	Arquivo de Patologia		ORINS	1957
Instituto Rocha Cabral, Lisbon		Travaux de Laboratoire Actualidades Biologicas	ORINS	1950
Junta de Energia Nuclear, Lisbon		Junta de Energia Nuclear	TISE	1959
ROUMANIA				
Academia Republicii Populare Romine, Institutul de Energetica, Bucharest	Studii si Cercetari de Energetica Revue d'Eletrotechnique et d'Energetique		ORINS	1958
Academia Republicii Populare Romine, Timisoara	Studii si cercetari stiintifice, Seria I Studii si cercetari stiintifice, Seria stiinte tehnice Studii si cercetari stiintifice, Seria stiinte chemice		ORINS	1958

ORGANIZATION	MATERIAL RECEIVED: SCANNED FOR NUCLEAR SCIENCE ABSTRACTS	MATERIAL RECEIVED: REFERENCE USE ONLY	MATERIAL DEPOSITED AT	DATE OF EXCHANGE AGREEMENT
Institut de Fizica Atomica al Academei R.P.R., Bucharest	Revue de Physique Studii si Cercetari de Fizica Preprints		ORINS	1958
Institutul Politechnic Bucuresti, Bucharest	Bulletin		ORINS	1957
SPAIN				
Consejo Superior de Investicacion Cientica-cion Internacional, Madrid		Archivos de Medicine Experimental	ORINS	1951
Instituto Nacional de Geofisica, Madrid		Revista de Geofisica	ORINS	1951
Ion, Madrid		Ion	ORINS	1950
Junta de Energia Nuclear, Madrid	Energia Nuclear		ORINS	1958
Laboratorio Central de Ensayo de Materiales de Construccion, Madrid		Publications Reprints	ORINS	1950
Medicina, Madrid		Medicina	ORNL	1950
Patronato "Juan de la Cierva" Investigacion Tecnica, Madrid		Revista de Ciencia Aplicada Hierro y Acero	ORINS ORNL	1950
Real Academia de Ciencias y Artes de Barcelona, Barcelona		Reprints	ORINS	1950
Real Academia de Ciencias Exactas, Fisicas y Naturales,		Revista	ORINS	1950
Real Sociedad Espanola de Fisica y Quimica, Madrid	Anales, Seria A Anales, Seria B		ORINS	1950
SWEDEN				
Aktiebolaget Atomenergie, Stockholm	Arkiv for Fysik		ORINS	1950
Allmanna Svenska Elektriska Aktie-bolaget, Vasteras	ASEA Journal		ORINS	1953
Chalmers Tekniska Hogskolas, Gothenburg		Transactions	ORINS	1953
Forsvarets Forskning-sanstalt, Ulriksdal		Reprints	ORINS	1950
Ingeniorsvetenskapsaka-demien, Stockholm		Acta Polytechnica	ORINS	1950
Institute of Theoretical Physics, Upsala		Reprints	ORINS	1950
Kungl. Tekniska Hogas-kolans Bibliotek, Stockholm		Handlingar Avhandlingar	ORINS	1950

ORGANIZATION	MATERIAL RECEIVED: SCANNED FOR NUCLEAR SCIENCE ABSTRACTS	MATERIAL RECEIVED: REFERENCE USE ONLY	MATERIAL DEPOSITED AT	DATE OF EXCHANGE AGREEMENT
Kungl. Veterskapsakademiens Bibliotek, Stockholm	Arkiv for Fysik	Arkiv for Kemi Arkiv for Matematik	ORINS	1950
Matematisk-Naturvetenskapliga, Stockholm		Dissertations	ORINS	1951
Nobelinstitutet for Fysik, Stockholm		Reprints	ORINS	1950
Svenska Lakaresallskapets Bibliotek, Stockholm		Nordisk Medicin	ORINS	1950
Svenska Traforskningsinstitutet Biblioteket, Stockholm		Meddelande	ORINS	1950
Universitetsbiblioteket, Uppsala		Reprints	ORINS	1950
University Library, Lund		Fysiografiska Sallskapets Forhandlingar	ORINS	1949
SWITZERLAND				
Bulletin Technique de la Suisse Romande, Lausanne		Bulletin Technique de la Romande	ORNL	1951
Conseil Europeen pour la Recherche Nucleaire, Geneva		Reports	TISE	1954
Ecole Polytechnique Federale, Institute of Physics, Zurich	Dissertations		ORINS	1950
Industries Atomiques, Geneva	Industries Atomiques		ORINS	1950
International Labour Office, Geneva		Occupational Safety and Health	ORINS	1950
Office Central Federal des Imprimes et du Materiel, Berne	Atomenergie		ORINS	1957
Physikalische Anstalt der Universiteet Basel, Basel		Reprints	ORINS	1949
Reaktor AG, Wurenlingen (AG)	Reaktor-Bulletin RAG reports		ORINS	1958
Societe Vaudoise des Sciences Naturelles, Lausanne		Memoirs	ORINS	1950
Stadtbibliothek Bern, Bern		Verhandlungen der Schweizerischen Naturforschanden Gesellschaft	ORINS	1950
Sulzer Brothers, Ltd., Winterthur	Sulzer Technical Review		ORINS	1950
Swiss Federal Institute of Technology, Zurich		Zeitschrift fur angewandte Mathematik und Physik	ORINS	1950
Universitatsbibliothek Tauschabteilung Schweizer Medizinische Akademie, Basel		Bulletin	ORINS	1950

ORGANIZATION	MATERIAL RECEIVED: SCANNED FOR NUCLEAR SCIENCE ABSTRACTS	MATERIAL RECEIVED: REFERENCE USE ONLY	MATERIAL DEPOSITED AT	DATE OF EXCHANGE AGREEMENT
Universite de Neuchatel, Institut de Physique, Neuchatel	Publications		ORINS	1959
University Bern, Physikalisches Institut, Bern	Dissertations		ORINS	1953
TURKEY				
Faculte des Sciences de l'Universite d'Istanbul, Beyazit-Istanbul		Revue	ORINS	1951
Istanbul Teknik Universitesi, Istanbul		Bulletin	ORNL	1949
Turkish Cancer and Radiobiological Society, Ankara	Monthly Bulletins		ORINS	1957
UNION OF SOUTH AFRICA				
Chemical, Metallurgical and Mining Society of South Africa, Inc., Johannesburg		Journal of the South African Institute of Mining & Metallurgy	ORNL	1950
Industrial Review of South Africa, Johannesburg	Industrial Review of South Africa		ORINS	1959
Medical Association of South Africa, Cape Town		South African Medical Journal	ORINS	1950
National Physical Laboratory, Pretoria		Publications	ORINS	1957
South African Association for the Advancement of Science, Johannesburg		South African Journal of Science	ORINS	1950
University of the Witwatersrand Medical School, Johannesburg		South African Journal of Medical Sciences	ORINS	1950
URUGUAY				
Federacion de Sociedades Medico, Cientificas del Uruguay, Montevideo		Archivos	ORINS	1950
Sociedad de Biologia de Montevideo, Montevideo		Archivos	ORINS	1950
USSR				
Academy of Sciences of the Ukranian SSR Kiev, Ukranian	Reports of the Academy of Sciences of the Ukranian SSR Ukranian Journal of Physics Symposium of Scientific Studies of the Institute of Metal Physics		ORINS	1958

ORGANIZATION	MATERIAL RECEIVED: SCANNED FOR NUCLEAR SCIENCE ABSTRACTS	MATERIAL RECEIVED: REFERENCE USE ONLY	MATERIAL DEPOSITED AT	DATE OF EXCHANGE AGREEMENT
Academy of Sciences of the Armenian SSR, Erevan, Armenia	Izvestiya Fiziko-Matematicheskikh Nauk (Bulletin of Physical and Mathematical Sciences) Izvestiya Khimicheskikh Nauk (Bulletin of Chemical Sciences) Izvestiya Geologicheskikh i Geograficheskikh (Bulletin of Geological and Geographical Sciences)		ORINS	1959
Academy of Sciences of the Bessarabian SSR, Minsk, Bielorussian	The Journal of Engineering Physics		ORINS	1958
Academy of Sciences of the Estonian SSR, Tallin, Estonia	Bulletin of the Academy of Sciences of the Estonian SSR		ORINS	1959
Academy of Sciences of the Lithuanian SSR, Vil'nyus, Lithuanian	Proceedings of the Academy of Sciences of the Lithuanian SSR		ORINS	1958
Academy of Sciences of the USSR, Leningrad-Centre	Akademiia Nauk SSSR, Doklady		ORINS	1958
	Zhurnal Fizicheskoi Khimii		ORINS	
	Zhurnal Prikladnoi Khimii		ORINS	
Joint Institute for Nuclear Research, Moscow		Reports	TISE	1959
Moscow University Scientific Library, Moscow	Bulletin		ORINS	1958
Physical Institute of the Georgian Academy of Sciences, Thilissi	Trudy		ORINS	1958
Saltykov-Shchedrin State Public Library, Leningrad	Pribory i Tekhnika Experimenta		ORINS	1958
State Central Medical Library, Moscow Ministry of Health	Bulletin of Roentgenology and Radiology		ORINS	1958
State Scientific-Technical Library of the State Scientific Technical Committee, Moscow	Nauchnye Doklady Vysshei Shkoly: Seriya: Fiziko-Matematicheskaya (University Scientific Papers: Series Physics and Mathematics) Izvestiya Vysshikh Uchebnykh Zavedenii Ministerstva Vysshego Obruzovaniya SSSR (Bulletin of the Universities of the Ministry of Higher Education USSR)		ORINS	1959
	VENEZUELA			
Academia de Ciencias Fisicas, Mathematicas y Naturales, Caracas		Boletin	ORINS	1960

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YUGOSLAVIA				
The Croatian Chemical Society, Zagreb	Croatica Chemica Acta		ORINS	1955
Drustvo Matematicara I Fizicara NRH, Zagreb	Glasnik Matematicko-Fizicki I Astronomski		ORINS	1955
Institute of Nuclear Sciences, "Boris Kidrich," Belgrade	Bulletin		TISE	1956
J. Stefan Institute, Ljubljana	Reports		TISE	1957

COMMUNICATION FROM ATOMIC ENERGY COMMISSION

* * * Mr. McKinney * * * requested a report on the utilization of the technical libraries that we have given to other countries.

Enclosed with this letter are two copies of a paper prepared by the Commission's Division of Information Services on the utilization of the libraries.

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UTILIZATION OF FOREIGN AEC DEPOSITORY LIBRARIES

SUMMARY

There is a wide divergence in the utilization of the depository libraries which have been established. About 35 percent of the countries which have well-developed atomic energy programs, a sizable body of trained personnel, and good library programs make extensive use of the collections. About 35 percent of the countries make limited usage of the collections, since their activity in the field of atomic energy is limited. About 30 percent of the libraries receive a relatively small amount of use. These libraries are located in countries that are just beginning programs in atomic energy and/or in which the depositories have recently been established.

It is our belief that, though many of the collections are not being used very extensively at present, their establishment is in the best interest of the U.S. Government. The collections will assist the recipient countries in developing their own nuclear program and will help to foster a cooperative effort throughout the world.

Currently, we are planning a series of workshops for the depository library staffs in Latin America and in the Far East. Our experience at the Geneva Conference indicates that such workshops help the participants to make better use of their collections and fosters a spirit of continuing cooperation with the United States and among all participants.

In some of the larger countries which make extensive use of the AEC collection it has been found that a single depository limits the usage of these materials. The main causes of this limitation are the distance of many of the users from the depository and the difficulty of satisfying simultaneous, multiple requests for the same document when only a single copy is available. It is hoped that this shortcoming will be overcome by the prudent provision of additional depository library collections on a selective basis to those countries demonstrating a strong justifiable need.

GENERAL DISCUSSION

To provide a concise presentation of the use of these depository collections, we are giving generalized description of the activity of large geographical areas rather than attempting to describe all 90

depositories individually. For this purpose, we have designated six geographical areas: Europe, Asia, Africa, Pacific area, Canada and Iceland, and Latin America. In addition, we will treat the international organizations as a separate unit.

Europe

Thirty-five depository libraries are in the following twenty European countries: England, Ireland, Scotland, France, Germany, Italy, Austria, Belgium, Denmark, Finland, Greece, Luxembourg, Netherlands, Norway, Poland, Portugal, Spain, Sweden, Switzerland, and Yugoslavia. Of these depositories 11 are in public libraries, 12 in institutes or universities and 12 in government agencies.

In these countries, it is almost universally true that the educational level is high, that education and research activity in the atomic field is considerable and that these collections have been established for a period of years. The collections are adequately housed, properly organized and trained personnel have been assigned to provide service. Consequently, there is a heavy demand on the publications and services of the depository libraries.

England and Germany, in particular, are making extensive use of materials. In addition to the collection being actively used by personnel in the atomic energy programs, the collections are available to universities, industry, and the general public. This is due, in large part, to the highly coordinated national library programs in these countries. These programs have established a comprehensive interlibrary loan system which can make an item housed in any library in the country available to any individual in the country who needs it.

The collections in France, Italy, Netherlands, Denmark, Norway, Switzerland, Poland, and Yugoslavia seem to be used extensively, but the usage seems to be restricted mostly to personnel in the government atomic energy programs, and to other governmental agencies, and to some degree to industries which are associated with the atomic energy program.

The collections in Ireland, Scotland, Austria, Belgium, Finland, Greece, Luxembourg, Netherlands, Portugal, Spain, and Sweden are used less extensively.

Asia

Twelve depository libraries are in the following 12 Asian countries: Burma, Ceylon, India, Iran, Iraq, Israel, Korea, Lebanon, Pakistan, Thailand, Turkey, Vietnam.

Of these, four are in institutes or universities and eight are in government agencies.

The collections in India, Israel, and Pakistan seem to have the greatest use. These, of course, are the countries which have established atomic energy programs and a substantial body of scientific and technical personnel. Only in Israel, however, has the collection been made generally available. In India and Pakistan, the usage has been limited substantially to personnel within the organization which houses the collection.

The other Asian countries, because of limited resources or relatively low educational level or small atomic energy programs, make much less use of the AEC collections. Two of these collections (Iran,

Vietnam) were established quite recently (Iran on February 8, 1960, and Vietnam on February 8, 1960) and are barely organized.

Africa

There are four depository collections in Africa, one each in the Belgian Congo, Egypt, Ghana, and the Union of South Africa. Two of these are in universities and two in government agencies.

With the exception of the Union of South Africa, the training and research programs in atomic energy in these countries are still in the formative stage. The Union of South Africa has a fairly substantial educational program and is doing some research in the field. Egypt, of course, is working hard to make progress in atomic energy and the usage will continue to increase in that country.

Pacific

Five collections have been established in the following five countries: Australia, Japan, New Zealand, Philippine Republic, and the Republic of China. Three of these collections are in universities and the others in government agencies.

The collections in Australia, Japan, and New Zealand are used very extensively. All three countries have national library programs through which the AEC materials are made available to government agencies, industry, universities, and the general public. The collections are adequately housed, well organized, and manned with trained staff who are experienced in servicing the materials.

The educational training and research in the field of atomic energy is at a high level which tends to increase the demand for the AEC materials.

In the Philippine Republic and Republic of China the training of scientists in the field has just begun and activity is still in the hands of a few specialists.

Canada and Iceland

There are four depository collections in this area, three in Canada and one in Iceland. Three of these collections are in universities and one in a government agency.

Canada, of course, has played a major role in the atomic energy program for more than 15 years and has a comprehensive program of education in the field. A well-coordinated national library program makes it possible for any organization or individual requiring AEC publications to obtain them on interlibrary loan. Because of the major activity in atomic energy and the long-term interest in the field, the usage of the collections is quite heavy.

All three collections are well housed, well organized and the libraries are staffed with trained personnel.

In Iceland the atomic energy educational and research programs have barely begun at the present time, usage is limited, largely, to a relatively small number of students and research personnel. The collection has not been completely organized since no staff members are familiar with organizing the collection.

Latin America

Sixteen depository collections have been established, one in each of the following countries: Argentina, Brazil, Chile, Colombia, Costa Rica, Cuba, Dominican Republic, Ecuador, El Salvador, Guatemala,

Haiti, Honduras, Mexico, Peru, Uruguay, and Venezuela. Of these depositories 10 are in government agencies, and 6 are in universities or institutes. In Chile, although the Ministry of External Relations is designated as the depository, the collection is housed and maintained by the University of Chile.

Among these nations the collections are used most extensively in Argentina, Brazil, Mexico, and Venezuela, the countries having the most advanced programs in nuclear energy in Latin America.

These four collections are adequately housed, well organized, and serviced by trained and experienced librarians. While most of the usage is by personnel directly connected with the atomic energy program, this usage pattern does not reflect a deliberate policy of restricting the flow of information. Apparently, there are relatively few personnel in other organizations in these countries whose work requires access to AEC material. The libraries in Mexico and Brazil have expressed a willingness to loan AEC materials to all requesters, and the collections are available to the public.

All four libraries issue accessions lists and prepare bibliographies which, in the case of Brazil and Mexico, are distributed widely throughout the country and to other Latin American countries. These four libraries do a limited amount of translating of AEC reports when a specific request is received. However, only Brazil and Mexico perform this service for organizations beside the one in which the collection is housed.

The collections in Chile, Colombia, Peru, and Uruguay are adequately housed and organized. In Colombia and Uruguay service is provided only to members of the organization housing the collection, while in Chile and Peru service is given to other organizations and to the public. The overall usage of the collections is not too great, since the number of trained personnel is limited and the atomic energy programs small.

Costa Rica, Cuba, Dominican Republic, Ecuador, El Salvador, Guatemala, Haiti, and Honduras have been slow in getting their collections organized due to limited funds, few personnel trained in the nuclear field or librarianship, and minimal interest in atomic energy.

International agencies

Six depository libraries have been established in international agencies, one each in Euratom, Inter-American Nuclear Energy Commission, International Atomic Energy Agency, Organization for European Economic Cooperation, United Nations, Geneva, Switzerland, and United Nations, New York City.

54953 O—60—vol. 2——9

LETTER OF TRANSMITTAL FROM ATOMIC ENERGY COMMISSION

In your letter dated January 6 you requested among other things reports from the Commission on the Geneva Conferences and the Commission's programs covering exhibits and special/topical conferences.

I am happy to enclose for your information two reports that have been prepared by our Office of Special Projects. These reports are as follows:

AEC Conference and Exhibits Program (including the two Geneva Conferences)

The AEC's Topical Conferences Program including Conferences supported under section 419, Mutual Security Act, 1954, as amended.

AEC CONFERENCE AND EXHIBITS PROGRAM

The United States Atomic Energy Commission's overseas conference and exhibits program is an important part of the U. S. Atoms-for-Peace program.

This program, authorized by the Atomic Energy Act of 1954, was designed primarily to facilitate the dissemination of technical information on the use of atomic energy in the fields of industry, agriculture and medicine, and the interchange of new ideas and techniques among the nuclear scientists of the free world.

To that end, the Commission has participated in scientific conferences in many parts of the world, not only with the presentation of thousands of technical papers but also with comprehensive exhibits of nuclear devices and associated equipment, together with explanatory displays.

The Commission also has participated in international fairs with scientific exhibits, components of which were utilized in cooperative research programs with scientists of the host countries, resulting in an even wider dissemination of knowledge and closer ties between members of the international scientific community.

In addition to the accomplishment of its primary mission--the dissemination of scientific and technical information in the development and utilization of atomic energy--the Commission's overseas program has produced a "dividend" of great importance to the United States foreign relations.

That collateral benefit has been the generation of a new and greater respect for American scientific stature among the general population of every area in which the program has operated.

The AEC program has reached directly nearly 3,000,000 persons, representing

virtually every country of Europe and Asia, and indirectly, as a result of word-of-mouth communication and the thousands of column-inches of newspaper space generated by the United States Information Service and other agencies, hundreds of millions more were affected.

The 3,000,000 who actually attended the AEC exhibits in Western Europe, Japan and India were able to see at first-hand such operating nuclear devices as gamma radiation facilities and reactors of many types, as well as animated demonstrations of the manner in which atomic energy is being used today in the United States in every field of human activity.

Similar scientific programs, with accompanying exhibits, now are being prepared for presentation in Egypt, Pakistan, Argentina, Brazil, Venezuela and Peru to tell the American story of "Atoms-for-Peace."

THE GENEVA CONFERENCES

The First and Second International Conferences on Peaceful Uses of Atomic Energy, held under United Nations auspices at Geneva, Switzerland, in 1955 and 1958, respectively, were by far the most important of the Commission's activities in the dissemination of scientific and technical information overseas.

Both conferences were attended by the leading atomic scientists of nearly every country in the world, and produced an exchange of data on a scale never before approached.

The First Geneva Conference grew out of President Dwight D. Eisenhower's proposal for the initiation of a world-wide "Atoms-for-Peace" program, made before the General Assembly of the United Nations on December 8, 1953.

In the following year, the U. N. gave its approval to a United States proposal for an international conference to promote the interchange of information on the peaceful atom, new uses for which were then being found almost daily and in many different parts of the world. Geneva was selected as the conference site.

To the Atomic Energy Commission, the United States Department of State assigned the task of preparing the entire technical program to be presented at Geneva--a program which was to encompass the scientific achievements of all groups in the United States then working in the field of atomic energy.

More than 3,000 organizations and individuals were invited to submit abstracts of papers to be presented at the conference; and all laboratories, universities, and industrial concerns then engaged in the atomic energy field were solicited for exhibits.

From the resulting abstracts and exhibit ideas came the final United States presentation.

A total of 1,428 delegates, representing 73 nations and 8 independent agencies, attended the historic First Geneva Conference, which opened on August 8, 1955. The United States delegation of 327 leaders in the field of nuclear energy was headed by Chairman Lewis L. Strauss of the Atomic Energy Commission.

During the two weeks of the Conference, the United States played a leading role, presenting 512 of the 1,067 scientific and technical papers, or nearly 48 percent. The papers covered all work then being done in this country both in fundamental research and in practical applications of atomic energy to industry, agriculture and medicine.

Important contributions of this country included new data in such fields as geology of raw materials, ore recovery and processing, basic nuclear constants, neutron cross-sections and in reactor design and development.

All of the papers presented at the technical sessions later were published in 13 volumes by the United Nations, as the Proceedings of the Conference, and form an important body of information available to all scientists.

Supplementing the U. S. papers program was a technical exhibit, a principal feature of which was an operating, pool-type research reactor, installed in a specially designed and constructed building on the grounds of the Palais des Nations. The reactor, the first to be exhibited on the continent of Europe, was constructed by the Oak Ridge National Laboratory and air-shipped, disassembled, to Geneva. It was reassembled in 14 days, and went critical in time for the opening of the Conference, where it was inspected by more than 63,000 persons. The reactor subsequently was sold to the Swiss Government.

Other exhibit items, housed in the Palais itself, included 10 reactor models, covering as many different types; a mobile radiological laboratory; a "hot lab," complete with master-slave manipulator; a cloud chamber; an array of radiation detection instruments; models of a chemical separation plant and an "atomic" greenhouse; and many other displays and equipment drawn from 105 different sources, including AEC installations, universities, and commercial and industrial organizations.

The United States also contributed eight of the twenty-one technical motion pictures exhibited by the United Nations, and maintained a well-stocked technical library for the use of the delegates during the conference. The library, which contained 150 commercially-published books on various aspects of atomic energy;

62 journals containing pertinent articles; 5,200 copies of AEC reports, indexed on 55,000 cards; and an additional 7,000 microcard reports, with two microcard readers.

A high spot of the Conference was the presentation by the United States to the United Nations and the heads of all official delegations of an eight-volume set of books covering the whole field of atomic energy in its peaceful applications, and containing a vast store of information previously classified for security reasons.

During the conference, a separate educational and commercial exhibition was presented in the Palais des Expositions, in downtown Geneva, with 150 exhibits presented by eight countries. The United States participated with an educational Atoms-for-Peace display and exhibits by 18 American commercial organizations and firms.

The First Geneva Conference produced a favorable comment throughout the world, and the United States Official Representatives declared it had made "a genuine contribution toward opening the way for world-wide cooperation to place atomic energy at the peaceful service of all nations."

So impressed were the Official U. S. Representatives with the success of the experiment in international cooperation that they requested the United Nations at once to make plans for a second conference to be held within two or three years.

In response to that request and subsequent formal negotiations between the U. S. Department of State and the United Nations, a Second International Conference was convened at Geneva on September 1, 1958.

The second conference, in most major aspects, was nearly double the entire size of the first. About 6,300 persons, including 2,700 accredited delegates

from 69 countries participated, compared with about 3,600 at the first conference. A total of 2,135 scientific and technical papers were submitted during the two weeks of formal sessions, and huge technical exhibit was presented in a specially-built 85,000 square foot building on the Palais des Nations grounds.

As in 1955, the Atomic Energy Commission planned and organized the presentation of the United States contribution to the Conference, offering a large and comprehensive program of technical papers, exhibits and films. Some 700 of the 2,135 papers were submitted by the United States, which also was the only country to give at least one oral paper during each of the 77 sessions of the Conference.

During the course of the technical sessions, a vast amount of new work in many fields was reported on, not only by American scientists but also by those of many other nations. In many cases, new lines of inquiry were opened by the discussions and, in a number of instances, the validity of the work of U. S. researchers was confirmed by scientists of other lands who independently had been pursuing the same ends.

Almost as valuable as the formal sessions were the informal get-togethers in corridors and lounges, where old ties were cemented and new friendships developed by scientists of all nations.

(All of the technical papers presented at the sessions are now being published as the Proceedings of the Conference by the United Nations, which thus far has produced 32 volumes. These are on sale to the public, and have had wide distribution throughout the world.)

The American technical exhibit, which was opened by President Eisenhower by trans-Atlantic telephone, furnished a fitting complement to the papers program.

The exhibit, occupying almost half of the total space shared by 21 other countries and specialized agencies, covered four broad areas of activity: the physical sciences, reactor science and technology, the life sciences, and fusion research. Present to explain and operate many of the exhibits were technicians and scientists, many of whom operated the same or similar equipment in their home laboratories.

The unveiling of the fusion area, containing actual operating thermonuclear devices, as well as models illustrating the principal channels of fusion research then being pursued in this country, coincided with the first public reports by the United States, the United Kingdom and Soviet Russia of experimental work being carried on independently in those countries.

Although the U. S. fusion exhibit was of great interest because of its novelty, many other displays were of similar interest to the delegates and visitors. Among them were two operating reactors--an Argonaut training reactor which was assembled in view of the audience during the first five days of the exhibition, and a TRIGA pool-type training and research reactor, which also was used to produce radioisotopes during the exhibit for use in other displays. (The TRIGA reactor subsequently was acquired by Lovanium University, at Leopoldville, Belgian Congo.)

The exhibit also included simulators, models and graphic displays illustrating all types of reactors then in operation in the United States; a wide range of demonstrations in fundamental physics; and displays of the most modern equipment and techniques employing radioisotopes in the fields of industry, agriculture and medicine.

As in 1955, the United States presented to the United Nations and to the heads of all official delegations a set of books (13 of them, this time) covering all new work in the field of atomic energy in this country since the previous meeting.

More than 35,000 copies of technical publications also were distributed at the U. S. Technical Information Center, where books, technical journals, reports and drawings were made available for the use of all delegates. The Center was one of the most popular spots at the Conference site, and many of the foreign delegates returned there day after day for study of U. S. scientific literature.

Adjoining the Center was a specially-designed motion picture screening facility in which 28 short technical films covering many aspects of the atomic energy picture were shown continuously throughout the Conference. In addition, the United States contributed 17 of the 51 longer films which were shown in the Palais theaters under U. N. auspices.

The Conference received wide coverage in the world press, which was represented by 911 reporters, feature writers and commentators from 36 countries, and a large portion of this coverage featured the U. S. participation, partly because of the size of the exhibit but primarily because of its broad scope and its uniform scientific excellence.

As before, a 13-nation commercial exhibition of nuclear products and services, occupying 150,000 square feet in the Palais des Expositions, was held concurrently with the Conference. Seventy-thousand persons visited this exhibition, which featured a central display in the U. S. section prepared by the Atomic Energy Commission and included exhibits by 52 U. S. firms and business and industrial organizations.

Among the U. S. displays at the commercial exhibition were two operating reactors: an AGN-201 research reactor, later purchased by the Institute of Physics of the University of Geneva, and an Atomics International L-77 laboratory reactor, which was transferred at the end of the Conference to an affiliate of the company in Duisburg, Germany.

At the close of the final session, Chairman Strauss characterised the Conference as "an outstanding success," and Francois Perrin of France, President of the Conference, expressed his gratitude for the "atmosphere of trusting cooperation...made possible by the unreserved disclosure of knowledge which has previously been kept secret."

The United States Official Representatives, at the close of the Conference, expressed similar satisfaction at the "vast amount of new technical information released on all phases of the peaceful uses of atomic energy," and recommended that the United States take steps to propose a third international conference in three years.

INTERNATIONAL FAIRS

In addition to its participation in the two Geneva Conferences, the Atomic Energy Commission supplied equipment and displays for American pavilions in a number of large international fairs and expositions. It provided an Atoms-for-Peace display for the Paris International Fair of 1957, and another for the American pavilion at the Brussels World's Fair in 1958. In addition, the AEC supplied an AGN 211 low-power research reactor for exhibition in the International Science Hall at Brussels--an exhibit which drew, among its many important visitors, King Baudouin of the Belgians. Display material also was provided for the Moscow

Exhibit of 1959, and in addition, AEC produced complete and comprehensive exhibits for three other large expositions overseas: the International Electronic and Nuclear Congress and Exposition, Rome, 1958; the International Trade Fair, Tokyo, 1959, and the World Agriculture Fair, New Delhi, India, which opened December 11 last and continues through February, 1960.

More than 83,000 persons visited the Rome exhibit, which featured an AGN-201 "baby reactor," the first operating reactor ever seen in Italy. The exhibit, which supplemented a ten-man technical papers delegation to the Congress from the United States, comprised a basic introduction to the subject of atomic energy, aimed at the non-technical visitor; a section on reactor science and technology, pitched at a much higher technical level; another section on the use of radioisotopes in industry, agriculture and medicine; and a final area devoted to an explanation of the U. S. program of international cooperation.

The exposition, which was under the sponsorship of the Italian Government and was opened by President Giovanni Gronchi, provided an effective medium through which to relay the Atoms-for-Peace story to Italy and southern Europe, and the U. S. exhibit was given recognition in the Italian press as the most effective display of the Exposition.

In May, 1959, the Atomic Energy Commission joined with the U. S. Department of Commerce in presenting a coordinated exhibit at the Tokyo International Trade Fair. The twin exhibits were housed in two identical buildings, one for AEC, the other for Commerce.

The AEC display, which was visited by an estimated 800,000 persons, was dominated by a huge model of the Shippingport reactor core, mounted outside the

building in an adjacent garden area. The 11,000 square foot exhibit consisted of four areas, devoted to reactors, isotopes, fusion, and a Technical Information Center which, like those in all other AEC exhibits, was a center of attraction throughout the show.

Another highlight of the U. S. exhibit was an American Standard UTR reactor, the first ever seen publicly in Japan, which inspired thousands of column-inches of news coverage and was the subject of hundreds of news pictures.

The reactor, which was visited by the Emperor and other members of the Royal Family of Japan, did much to allay the fears of the Japanese people regarding the possible consequences of a wide use of atomic energy, even in its peaceful applications.

In addition to the steady streams of visitors who poured through the show, the exhibit reached another estimated 10,000,000 persons through the medium of television, for the program was telecast live on a popular weekly scientific show over station NKTV.

Although it was widely acclaimed on a popular level, the U. S. exhibit had a much more important influence on the Japanese scientific community, more than 500 ranking members of which visited the pavilion to witness the demonstrations and to make use of the Technical Information Center.

Unique among the AEC exhibits is that currently on display at the World Agriculture Fair, in New Delhi. President Eisenhower, then on his good-will tour to India, officially opened the American exhibit, a joint effort with the Departments of Commerce and Agriculture, and then visited the atomic energy building with President Prasad of India. The President formally started the TRIGA reactor, which was one of the important AEC exhibits.

Unlike previous AEC efforts, the New Delhi exhibit is confined to a single facet of the atomic energy picture--the uses of radiation and radioisotopes in agriculture--making possible a more closely-knit and understandable display than ever before was possible.

The exhibit, housed in its own brick and concrete building--the creation of the Japanese-American architect, Minoru Yamasaki--tells in terms simple enough for the average layman to understand a story important enough to interest the most sophisticated of Indian scientists: the story of the Atom on the Farm.

At the time of writing, more than 1,500,000 Indians, including virtually every important scientist in the fields of atomic energy and agriculture, had visited the exhibit; and it was anticipated that the figure would exceed 2,000,000 before the Fair closes at the end of February.

The exhibit, though simply conceived, is replete with spectacular displays, including an operating TRIGA reactor and a 5,000-curie gamma irradiation facility, both of which are being used throughout the Fair in cooperative research programs by Indian and American scientists. The reactor also is producing radioisotopes for the use of Indian hospitals, laboratories and other scientific facilities.

One of the most attention-getting of the displays is the Cinedome, a huge, hemispherical motion picture screening facility which literally puts the audience into the picture and gives the spectator the feeling of moving into the scene with the camera. Here, in the first showing of the new technique outside the United States, was presented a brief film introducing the audience to The Atom on the Farm.

The ensuing displays demonstrated in easily-understood terms what causes radiation, how radioisotopes are made, how they are handled, and, in successive

demonstrations, how they are used specifically to enable farmers to grow better and more abundant crops at lower cost.

This was accomplished in sections devoted to fertilizer and plant studies, radiation genetics, animal studies (with a live goat exhibit of a thyroid study, using radioisotopes); an insect exhibit, including a demonstration with live fruit flies of the method by which the United States has wiped out the screw-worm fly in Florida by means of radiation sterilization of the male flies.

A large and active Technical Information Center, which has been a hive of scientific activity since the opening of the Fair, completes the exhibit.

The New Delhi exhibit offered an unusual opportunity for the establishment of cooperative projects with the scientists of the host country and, in fact, it has become almost as much an Indian exhibit as an American offering. It is staffed entirely by Indian guides--young scientists trained for two weeks before the opening by the American scientific staff--and Indian aides are assisting in both the reactor and gamma facilities. In addition, through a cooperative agreement reached with the Indian Agricultural Research Institute at Pusa, many of the mutant plants for the radiation genetics exhibit were grown at Pusa from irradiated seeds flown there from the Brookhaven National Laboratory, on Long Island.

The Atomic Energy exhibit also was the scene of several sessions of a special Institute on Radioisotopes, held during the fair at the Pusa institution. Young members of the staff of the Indian Atomic Energy Establishment, at Trombay, also have received training in relays in the reactor exhibit by arrangement with Dr. Homi J. Bhabha, Chairman of the IAEE.

The American exhibit as a whole, including the portion presented by the Department of Agriculture, has generated more than 14,000 column inches of space in Indian newspapers, and a large share of this total was devoted to the AEC exhibit. In addition, the U. S. participation received wide publicity in the newspapers and magazines in the United States. This phase of the program was handled by the U. S. Information Service.

An accurate evaluation of the New Delhi accomplishments is impossible at this early date, but on the basis of comments in the Indian press and from leading officials, both of this country and of India, it has been one of the most successful exhibits which AEC has produced.

FUTURE EXHIBITS

At the request of the Department of State, AEC now is preparing two additional exhibits, one to be shown in both Cairo, Egypt, and in Karachi, Pakistan; the other to be exhibited in Argentina, Brazil, Venezuela, and Peru.

The Cairo-Karachi exhibit will open first in Egypt, on May 8, 1960, and will be on view there until May 30, when it will be "rolled up" and shipped to Pakistan for another engagement during October of the same year.

This exhibit, which will emphasize nuclear power production but will also cover the uses of atomic energy in industry, agriculture and medicine, will utilize the same building which housed the Tokyo exhibit, and will be unique in that all of the displays are being fabricated in the United States and are specially designed for portability.

Like the New Delhi exhibit, the Cairo-Karachi display will include an

operating reactor (a UTR), a gamma facility, and a well-equipped Technical Information Center which will stock not only a cross-section of current American literature on atomic energy but also a library of technical films covering many aspects of that subject.

As in New Delhi, negotiations now are going forward on the establishment of cooperative research programs in which the two operating nuclear facilities will be utilized to promote Egyptian research.

The exhibit will feature a wide range of equipment and displays illustrating specific techniques by which atomic energy is used in industry, agriculture and medicine.

Several of the areas will be introduced by short motion pictures produced especially for this purpose.

The South American exhibit, which also is being prepared by the Atomic Energy Commission at the request of the Department of State, will be a "package show" too, capable of quick "roll-up" and transport.

It too will deal with all peaceful uses of atomic energy, and will be supplemented by scientific programs in each of the countries it visits.

This exhibit is expected to open in Brazil in the Fall of 1960; then will move to Argentina for a Winter show; Venezuela for the Spring of 1961; and will wind up its tour in Peru during the summer of that year.

In all of these presentations, the Commission will work in the closest cooperation with the Departments of State and Commerce, the International Cooperation Administration, and the United States Information Agency.

Up to the present, the Commission has exhibited nine operating nuclear reactors overseas--five of them in a single year--and they, together with the

54953 O—60—vol. 2——10

accompanying displays and demonstrations, have done much not only to allay fears but also to stimulate many other nations into themselves acquiring reactors and other nuclear energy devices and equipment.

A summary of the exhibits presented by the Commission follows:

DATE	EXHIBIT	LOCATION	SQ. FT.	ATTENDANCE	OPERATING REACTOR SHOWN
Aug.1955	Conference on Peaceful Uses of Atomic Energy	Geneva, Switzerland	7,000	63,400	Swimming pool prototype, 100 KW, 20 per cent enriched U-235, built by the Oak Ridge National Laboratory
Apr. - Oct. 1958	Brussels World Fair (U.S. Pavilion and International Science Hall)	Brussels, Belgium	1,000	11,500,000	AGN 211 Reactor - low power research reactor Aerojet-General Nucleonics
June 1958	Rome Exhibit	Rome, Italy	10,000	83,000	AGN 201 Reactor - low power research reactor Aerojet-General Nucleonics
Sept. 1958	Conference on Peaceful Uses of Atomic Energy	Geneva, Switzerland	40,000	100,000	Argonaut Reactor - 10 KW training reactor built by the Argonne National Laboratory. Triga Reactor - General Dynamics Corporation low power training and research reactor.
Sep. 1958	Geneva Commercial Exhibit (made up primarily of commercial displays)	Geneva, Switzerland	32,900 (AEC portion 8,000)	70,000	L-77 low power laboratory reactor - Atomics International AGN 201 Reactor - low power research reactor Aerojet-General Nucleonics
May 1959	Tokyo International Trade Fair (w/Dept. of Commerce)	Tokyo, Japan	11,000	800,000	UTR Reactor - University training Reactor American Standard and Radiator Corporation
Sept. 1959	IAEA Third General Conference	Vienna, Austria	500	undetermined	
Oct. 1959	Century 21 Preview	Seattle, Washington	500	6,000	
Dec. 1959 - Mar. 1960	New Delhi World Agriculture Fair (w/Depts. of Commerce and Agriculture and USIA)	New Delhi, India	14,000	1,000,000 -plus	Triga Reactor - low power training and research reactor - General Dynamics Corporation

USAEC TOPICAL CONFERENCE PROGRAM INCLUDING CONFERENCES SUPPORTED UNDER SECTION 419, MUTUAL SECURITY ACT, 1954, AS AMENDED

The U. S. Atomic Energy Commission on an annual basis supports a number of international scientific conferences. The extent of participation varies in accordance with the sponsorship of the conference, AEC interest, nature of the meeting and its location. The general scope of participation covers such areas as nuclear technology, uses of radioisotopes in medicine, biology, and agriculture, radioisotopes in the biosphere, radiochemistry, application of radiation sources, and other topical subjects in the atomic energy field. Participation is accomplished normally in one of three ways, (1) under the AEC Program for Support of International Scientific (Topical) Conferences; (2) support of regional and other training and education conferences with funds under Section 419, Mutual Security Act of 1954, as amended; and (3) support of a wide range of international conferences which are of direct programmatic interest to the AEC. This report does not include the last item since this method of participation is organized by contractors in accordance with their respective programs and financed with AEC funds provided under contract.

The first major attempt at the re-establishment of world-wide communication among atomic scientists was the 1955 International Conference on the Peaceful Uses of Atomic Energy. As a result of this Conference, it was recognized that a real need existed for a more intensive treatment of scientific matters in several areas related to atomic energy than could be afforded by the "Geneva" -type conference.

It was believed by U. S. scientists that in the intervals between large conferences many opportunities would be presented for more specialized conferences in which the U. S. should participate.

The AEC, in carrying out its responsibilities under the Atomic Energy Act for disseminating technical information, recognized the value of international conferences as a means of accomplishing these responsibilities. A review of conferences being convened during the year 1956 revealed that a number of conferences were being sponsored by private institutions and organizations in the United States. Financial assistance was regularly sought by these institutions from various sources including U. S. Government Agencies. Among these were Office of Naval Research, Office of Scientific Research, Air Force, National Science Foundation, and the National Institutes of Health. It was further determined that the AEC had a direct interest in many of the conferences and that they merited financial support. It was also believed that by participation in these conferences the United States could gain many of the same advantages from the exchange of scientific information, as were accrued from participation in the Geneva Conference. Accordingly, in January 1957, the Commission approved a program including financial support for a selected number of unclassified conferences on specialized scientific subjects relating to atomic energy.

The first proposals received under this program were by the University of Wisconsin seeking assistance for the Fifth International Conference on Low Temperature Physics and Chemistry; and by Columbia University for support of International Conference of Neutron Interactions with Nuclei. The proposals, in accordance with established criteria under the AEC Program for Support, contained detailed information on agenda, participants, plans for publication of proceedings,

and anticipated tours subsequent to the conferences. These requests were reviewed for determining the scientific level of the conference to merit AEC support, allocation of funds, and international advantages to be derived from participation. Both conferences were approved for AEC support and resulted in a wide interchange of ideas and information in the respective areas of atomic energy. The extension and refinement of new techniques expressed at these conferences have given promise of a wealth of new experimental information to U. S. scientists.

From 1957 to the present, the AEC has supported 22 international conferences or symposia under its program for support of international scientific conferences. There are presently 9 additional conferences scheduled for 1960. Of the 22 conferences supported to date, 15 were held in the United States while 7 were convened abroad.

Of those conferences taking place in the United States a total of 815 foreign scientists attended representing as many as 53 countries throughout the world. The number of U. S. attendees at these meetings was approximately 3,500. The total number of scientific papers presented was approximately 1,235. The total number of U. S. participants at conferences in foreign countries was approximately 210. At these conferences over 430 papers were presented.

It is generally recognized that international conferences sponsored by a private institution should be supported by a number of interested organizations. It is believed that support coming from multiple sources assures wider participation and accordingly, a broader exchange of scientific information. The AEC in its support of scientific conferences has endeavored to support those conferences which are financed by other interested government agencies and private organizations

In this regard the AEC has been the sole contributor to only two of the twenty-two conferences supported to date.

The nature of scientific progress and the contribution of international conferences and symposia to this progress cannot be completely and immediately evaluated until after a lapse of a considerable period of time. However certain immediate results of AEC participation in conferenceshave been made evident:

1. The acquisition of information on recent scientific advances not readily available in the United States. This advantage was evident as a result of the International Symposium on Bioenergetics held in October, 1959, at the Brookhaven National Laboratory. Subsequent to the Symposium at least three AEC contractors indicated that they planned to reorient their research programs to incorporate ideas expressed at the meeting.

2. The establishment of a channel through which U. S. scientists may exchange information with interested scientists in foreign countries. The International Symposium on Radioisotopes in the Biosphere conducted by the University of Minnesota during October, 1959, illustrated this result. The Symposium, considered timely because of the recently reported Strontium 90 contents of Minnesota wheat samples, not only created a channel for U. S. scientists to receive important information from foreign sources, but also to disseminate desired information to foreign scientists. Numerous requests have been received since the Symposium from scientists throughout the world for copies of papers presented at the meeting.

3. Assistance to foreign countries in the development of atomic energy programs. This result was exemplified in the International Conference on Solid State Physics held in Melbourne, Australia during August, 1959. It has been reported that the papers presented by U. S. scientists made important

contributions to Australian scientists in the area of solid state physics. Prior to the Conference the Australian scientists were somewhat isolated from other scientific communities carrying on this type of work. It is believed that recognition of their endeavors, as well as the incorporation of new ideas received from U. S. scientists, will assist them in the development of their atomic energy programs.

One direct result of international conference participation has been the creation of a free and uninhibited atmosphere in which scientists from various countries may informally discuss mutual work and problems. It has been noted that these conferences have served U. S. scientists to establish working relationships with foreign scientists, and through continuing personal contact it is believed that both U. S. and foreign research in atomic energy will benefit. The AEC program for support of topical conferences has been successful in meeting the objectives for which it was established, i.e. to assist the U. S. scientists in the acquisition of knowledge on recent scientific advances; to help lower the barriers impeding the interchange of information among nations; and to promote the peaceful uses of atomic energy throughout the world.

The AEC has also initiated and supported certain conferences and symposia designed to foster the training and education of scientists engaged in the atomic energy programs of under-developed countries. These conferences have been supported by funds under Section 419, Mutual Security Act of 1954, as amended. The most important of these meetings were the First and Second Inter-American Symposia.

Inter-American Symposia were planned as a result of recommendations contained in the Report of the Panel on the Impact of the Peaceful Uses of Atomic Energy to the Joint Committee on Atomic Energy, dated January, 1956. Planning for the first of these Symposia, began early in 1956 when

representatives of the Department of State, ICA, and the AEC met to consider a proposal by the AEC to hold a meeting of representatives from all of the 21 American Republics in which the various aspects of nuclear energy would be discussed.

The First Symposium was convened in May, 1957, at the Brookhaven National Laboratory. The objectives of the Symposium were: (1) to clarify the present and explore the future uses of atomic energy in the American Republics; (2) to call attention to the practical efforts necessary to support and accelerate the development of atomic energy; (3) to stimulate increased effort in the development of atomic energy; and (4) to foster cooperation and the interchange of scientific information among the American Republics.

The agenda of the Symposium was covered in both general and parallel sessions. It included discussions and papers on atomic energy as related to areas of management, nuclear technology, raw materials, medicine, biology and agriculture.

There were small technical exhibits displayed at the Symposium which supplemented the scientific and technical papers which were presented at the Symposium. Some of the exhibits were a part of the Atoms for Peace exhibit, and others were contributed by the national laboratories. In addition Dr. Humberto Fernades-Moran, Director of the Venezuelan Institute for Neurology and Brain Research exhibited scale models and color photos of the institute and the research reactor.

Following the Symposium at the Brookhaven National Laboratory the Latin American participants were provided two week tours of AEC and other governmental facilities, universities, hospitals and a few industrial establishments engaged in peaceful nuclear research. The itineraries for these tours were developed by the AEC and an endeavor was made to relate the visits to the facilities to the agenda topics of the Symposium. Five separate tours were developed and

concerned the areas of management, reactor technology, raw materials, medicine, biology and agriculture. Each Latin American participant was given the opportunity to select a tour of his specific interest, therefore, to associate with other scientists doing similar work from other countries.

The Symposium was attended by 101 representatives of 20 Member States of the Organization of American States. In addition to the Latin Americans, there were 134 participants of which 116 were from the United States, 6 from Puerto Rico, 5 staff members of the Pan American Union and 7 other Latin Americans who were in the United States at the time of the Symposium.

It has been reported that the Symposium laid the ground work for the newly established Inter-American Nuclear Energy Commission which gives hope for a coordinated plan for development of nuclear energy in Latin America. It should also be noted that the Symposium afforded the first opportunity to scientists, engineers, and atomic energy officials of the American Republics to meet in a single group. They were able to discuss mutual work and problems in the nuclear field. The personal contacts established at the Symposium have been of mutual benefit to the individual countries represented at the meeting. It was the general consensus of participants that it would also be beneficial to all countries if future symposia could be convened, possibly in Latin America, dealing with specific areas of atomic energy. This hope was fulfilled with the Second Symposium held in Buenos Aires during June, 1959.

The Second Symposium, unlike the first meeting which concerned the whole field of nuclear energy, was confined to the particular areas of research on the uses of radiation and radioisotopes in the biological, medical and agricultural sciences. This Symposium was organized by the Organization of American States with technical assistance from the USAEC which was represented on various planning committees, i.e. finance, agenda.

The Symposium was convened at the Medical School of the National University of Buenos Aires, and 150 persons registered. Of this number, 70 were from Argentina, 66 were from other Latin American countries and 14 from the United States. The registrants were mostly medical or research scientists in the biological and agricultural fields. There were 32 papers presented at the Symposium and of this number 12 were by U. S. representatives.

The agenda for the meeting included the general areas of Botany, Zoology, Insectology, Radiobiology, Agriculture and Medicine. Specific papers and discussion topics covered radiation genetics, effects of infrared and ultraviolet rays, hazards of radiation, safety measures concerning radiations, uses of radioisotopes in agriculture, food preservation by ionizing radiations, radioisotopes and coffee, carbon 14 in physiological studies and hematology.

The most impressive thing about the Symposium was the very active participation, both in giving papers and even more so in discussion, by representatives of Latin American Republics. They freely discussed their mutual problems and the interchange of ideas became quite informal. As a result of this atmosphere, informal agreements were reached by various small groups to meet at future dates and further compare their respective research. There were also invitations extended to individual scientists to visit laboratories and research institutions in other Latin American countries. The results of this Symposium augur well for future nuclear energy symposia in South America.

Later in the year 1959 there was convened at the University of Puerto Rico an Inter-American Symposium on Legal and Administrative Problems in a Nuclear Energy Program. This Symposium was sponsored by the University and the Pan American Union with assistance from the U. S. Atomic Energy Commission. It was held at San Juan, Puerto Rico during November 16-19, 1959. Attendance included

25 participants from Latin American countries, 25 from the United States, and 2 from Canada. Representatives of the Puerto Rican Nuclear Center, the University of Puerto Rico and the Commonwealth Government also attended.

The agenda for the meeting included papers and discussion topics on the nature and uses of nuclear material and facilities; safety problems associated with wide use of radiation sources; government activities to protect against radiation hazards; liability; legal framework for atomic energy programs; international cooperation and special problems of the Latin American countries. The U. S. representatives presented papers on several selected agenda topics. These presentations were of a high caliber and contributed substantially to the success of the meeting.

The USAEC contributed several pamphlets and booklets containing technical information, copies of atomic energy legislation, regulations and other basic information on atomic energy. These materials were compiled into "information packets" one of which was given to each participant as he registered for the Symposium. Latin American representatives expressed their appreciation for the "information packets" and believed that they would be useful in the development of their atomic energy programs.

This Symposium also provided again the opportunity for Latin American scientists to gather and to discuss mutual problems particularly if they related to the legal and administrative aspects of their programs. The value of these informal discussions together with information presented at the formal sessions should prove to be worthwhile and useful to the Latin American countries and also make a valuable contribution to the Atoms for Peace Program.

Mutual Security Program funds were used by the AEC to support another international conference in 1959; namely, the Conference on Disposal of Radioactive

Wastes. This Conference was sponsored by the International Atomic Energy Agency and held in the Principality of Monaco during November 16-21, 1959.

The purpose of the Conference, jointly organized by the IAEA, the U. N. Educational, Scientific and Cultural Organization, and with the active cooperation of the Food and Agriculture Organization of the U. N., was to discuss problems with a view to preventing radioactive polution of man's surroundings. Because of its active interest in this area, the USAEC organized the U. S. participation for the Conference. Twenty-two scientists were selected to present papers on agenda topics. It has been reported that the U. S. presentations were impressive in their detail and technical content.

The Conference served the very useful purpose of providing a public forum for discussion of questions on disposal of radioactive wastes. Proceedings of the Conference will undoubtedly serve as a source of technical material for many future conferences and also should provide a base for attempts to reach an international agreement on the practices of disposal of radioactive wastes into the public seas of the world.

APPENDIX

TOPICAL CONFERENCES SUPPORTED

1. THE FIFTH INTERNATIONAL CONFERENCE ON LOW TEMPERATURE PHYSICS AND CHEMISTRY

This Conference was sponsored by the University of Wisconsin and held at Madison, Wisconsin, August 26-30, 1957. In attendance were 135 scientists representing 15 foreign nations. In addition, there were approximately 200 representatives from the United States. The AEC financial support of this conference was used for defraying a reasonable share of administrative expenses connected with the conference. Other contributors to the conference were the National Science Foundation, U. S. Industries, Office of Naval Research, and the University of Wisconsin. Some of the general areas of subject matter covered at the conference were superconductivity; transport, thermal, and state properties of substances; paramagnetism; nuclear resonance; electrical and diamagnetic effects, and other fundamental aspects of low temperature research. Since it has been known for some time that European nations have gone much farther with the subject of low temperature physics and chemistry than the U. S., the contribution of foreign scientists to the conference therefore directly benefited the United States.

2. THE INTERNATIONAL CONFERENCE ON NUETRON INTERACTIONS WITH NUCLEI

This Conference was held at Columbia University, New York City, during September 2-13, 1957. It was sponsored by Columbia University. In attendance were 57 scientists representing 12 foreign nations and 188 U. S. participants. The subject matter of the Conference concerned low energy neutron spectroscopy, process of fission, fast neutron total and divisional cross sections and gamma rays emitted after neutron capture.

In addition to AEC support of this Conference, other contributors were the Office of Scientific Research (Air Force), Office of Naval Research, International Union of Pure and Applied Physics. AEC entertained a major interest in the Conference since it was particularly applicable to the research program of the AEC.

The wide interchange of ideas and information on neutron physics resulting from various experiments conducted throughout the world enlightened all scientists who attended the Conference. The extension and refinement of new techniques gave promise of a wealth of new experimental information to U. S. scientists.

3. INTERNATIONAL CONFERENCE ON MEASUREMENTS AND STANDARDS OF RADIOACTIVITY

The National Academy of Sciences sponsored this Conference which was held at Tidewater Inn, Easton, Maryland, October 9-11, 1957. Discussions concerned new techniques and recent accomplishments in the measurements of radioactivity, measurements which are basic for medical research and industrial applications. The meeting was attended by 11 scientists from foreign countries and 6 U. S. scientists.

The AEC financial assistance to the Conference was used to defray a portion of cost of U. S. travel of selected guests and the preparation and publication of proceedings. The National Academy of Sciences also contributed to the overall support of the Conference.

The Conference brought forth information on the new developments for standards for strontium-90, cesium-137, and thallium-204. New requirements for standards for isotopes presently used in medicine, research, and industry were also discussed.

4. THE VIIth INTERNATIONAL CANCER CONGRESS

This Congress and associated meetings and symposia were held in London, England, July 6-12, 1958. The International Union Against Cancer sponsored the Congress, and the National Academy of Sciences - National Research Council sponsored the travel of 104 U. S. investigators. NAS requested financial support from the AEC and several other interested agencies. The AEC was requested to contribute to the payment of travel expenses of 16 U. S. investigators who otherwise would have been unable to attend. The general subject matter of the Congress concerned experimental and clinical aspects of cancer and cancer control.

Participation in the International Cancer Congress enabled leading scientists in our Commission-supported laboratories, as well as our off-site contractor personnel in various universities, to exchange views and opinions on the current status of cancer research. The interchange of information between U. S. and foreign scientists plus the opportunity to associate freely at such a meeting was invaluable in promoting good relations among the attending scientists as well as among the countries of the world represented at the Congress.

AEC contractor personnel made substantial contributions to the Congress, with well over 30 papers presented which were based on AEC-supported research. AEC support of the Congress was definitely beneficial to the B&M research program.

5. INTERNATIONAL CONGRESS ON RADIATION RESEARCH

The National Academy of Sciences - National Research Council and the Radiation Research Society sponsored this Congress which was held in Burlington, Vermont during the period August 10-16, 1958. The Congress provided opportunity for communication of results and ideas among leaders in such areas of research as: radiations protection and treatment; military, medical and industrial uses of

radiation, such as food processing and preservation; plant and human genetics; chemical and physical modification and synthesis. Attendance at the Congress was sizeable and included approximately 160 research scientists from 30 foreign countries, as well as several hundred from the United States. Geneticists, physicists, chemists, and biologists delivered more than 300 papers.

The AEC contributed to the partial support of expenses of U. S. principals and speakers, and for the publication and distribution of the proceedings. The AEC was requested to provide funds since radiation research is of programmatic interest to the AEC. It is interesting to note that the opening meeting coincided with the release of the U. N. Scientific Committee report on the effects of atomic radiation.

The Congress produced a number of startling releases such as development of medical pills for radiation protection; possibility of radiation protection through new drug "Streptomycin" combined with bone marrow cells for injection; and predictions of cures from radiation damage.

6. 1958 INTERNATIONAL CONFERENCE ON SEMI-CONDUCTORS

The University of Rochester sponsored an international conference on semi-conductors held at Rochester, New York, August 18-22, 1958. The AEC, along with the National Science Foundation, Office of Naval Research, Air Force Office of Scientific Research, and the International Union of Pure and Applied Physics (UNESCO) supported the meeting.

This Conference has a history dating back to 1950 when it was held in Reading, England; in 1952 at Bristol, England; in 1954 at Amsterdam, Holland; and in 1956 at Garmisch-Partenkirchen, Germany. The Conference at Rochester, New York was attended by approximately 110 scientists representing 14 foreign countries, plus some 350 from the United States.

54953 O—60—vol. 2——11

The AEC gave financial support which was used in meeting U. S. transportation costs and living expenses of foreign scientists, publication and printing costs, and other administrative expenses. The benefit to the AEC from its support of the Conference was the acquisition of information on recent developments concerning the fundamental concepts of electronic processes in semi-conductors, including both the theory underlying these concepts and the experiments which shed light on them.

7. SYMPOSIUM ON HEALTH PHYSICS IN BIOLOGY AND MEDICINE

This Symposium was sponsored by the University of Puerto Rico and held at the University of Puerto Rico during the last week of May, 1958. The Symposium was the result of an expression of interest by Latin American countries that such a meeting might be held with qualified people from the Latin American countries and U. S. scientists for the purpose of exchanging information in the field of health physics. The subject matter covered discussions on radiation damage, permissible dose levels and other aspects of the philosophy of health physics. The agenda also concerned uses of radiation and the safety measures defined in relation to basic medical research. In attendance were 15 scientists from Latin American countries, 26 representatives from the University of Puerto Rico and 9 participants from the United States.

Material presented at the Symposium offered a basis for planning future activities at the Puerto Rican Nuclear Center. The presentations and discussions gave an accurate picture of the educational needs of Latin America in the fields of Health Physics and basic and clinical Medical research in nuclear science. It is believed that the Conference assisted the AEC in preparing to meet the needs of Latin American scientists in the field of health physics.

8. CONFERENCE ON STOPPING POWER

The National Academy of Sciences sponsored this Conference which was held at Gatlinburg, Tennessee, September 15-18, 1958. The Conference dealt with the penetration of charged particles in matter, and offered 30 U. S. and 25 scientists from 11 foreign countries, having active research programs in this area, the opportunity to meet and clarify mutual problems.

The AEC and the National Science Foundation financially contributed equal amounts. AEC funds were used in meeting a share of expenses, such as travel and living expenses of selected U. S. and foreign guests, stenographic and clerical services, and publication of proceedings.

It was determined from conference discussions that a sufficiently firm basis for extrapolation of stopping power relations could be laid to permit a new attempt in this direction. Although it is not possible to gage the benefit derived by the U. S. from participation in the meeting, the Division of Research has advised that the subject matter of the Conference was consistent with the research mission of the Commission. The ideas generated and expressed at the Conference will result in future developments in research in the United States.

9. CONFERENCE ON CONSTRUCTION OF MEDIUM ENERGY CYCLOTRONS

The National Academy of Sciences - National Research Council's Subcommittee on Instruments and Techniques sponsored this Conference which was held at Sea Island, Georgia, February 2-4, 1959. Approximately 75 U. S. scientists from the various laboratories and 12 foreign scientists from six countries attended and were given the opportunity to clarify mutual problems and to stimulate more fruitful direction for investigation. The AEC and the National Academy of Sciences financially supported the meeting.

The Conference centered attention on problems associated with the design and construction of a new type of fixed frequency cyclotron. Considerable attention was given to development of the ion orbit theories, calculation of complex magnetic field configurations, and measurements made with model magnets. In seven very active sessions a total of 50 informal contributions were made by 40 scientists. Several laboratories reported initial operating experience with experimental machines and models. Special features for improving beam quality, providing variable frequency to accelerate different ions to various energies, and for improving beam deflection were discussed.

It has been determined prior to the Conference that there were several groups in the United States and abroad which were designing, building or contemplating building cyclotrons which would be superior to the classical cyclotrons in present use. The timely exchange of design information at the Conference permitted savings in time and money greatly exceeding the cost of the meeting.

10. CONFERENCE ON MOLTEN SALTS

This Conference was held at New York City under the auspices of the New York Academy of Sciences on April 13-15, 1959. It was convened for the purpose of stimulating the interchange of ideas on the results of recent research in the field of molten salts. Five foreign scientists representing five foreign countries attended the meeting and engaged in the scientific discussions.

The Office of Naval Research and the Atomic Energy Commission gave equal financial support to the Conference. AEC funds were used to pay a share of the costs related to publication of proceedings and travel and per diem expenses of selected speakers.

It was generally agreed by the participants that the Conference contained a substantial amount of new information. Papers were confined to reports of current research rather than survey articles. Topics discussed most actively were the structure of molten salts as revealed by a variety of physical measurements and the activity of coefficients in molten salts systems. A fund of basic chemical knowledge on molten salts systems was developed as a result of the Conference, and which should enhance future research projects in the United States.

11. SYMPOSIUM ON QUANTITATIVE BIOLOGY

The Long Island Biological Association, Inc. sponsored this Symposium at Cold Spring Harbor, New York during the period of June 3-11, 1959. In attendance were fifty scientists including biologists, chemists, physicists, mathematicians, and social scientists. Of this group nineteen came from abroad and represented ten foreign countries. The following topics were discussed: raw materials of evolution, action of natural selection, isolating mechanisms, speciation, ecological systems, and fossil record and rate of evolution. The National Institutes of Health, National Science Foundation, Carnegie Corporation and the Rockefeller Foundation as well as the AEC financially supported the Symposium.

The interchange of information between U. S. and foreign scientists plus the opportunity to associate freely at the Symposium resulted in the promotion of good relations among the attending scientists. AEC support of the Congress was beneficial to the Division of Biology and Medicine research program.

12. SYMPOSIUM ON THE IMMEDIATE AND LOW LEVEL EFFECTS OF IONIZING RADIATIONS

This Symposium was held at Venice, Italy, during June 22-26, 1959. It was organized under the joint sponsorship of UNESCO, the IAEA, and the Italian CNRN.

12. IMMEDIATE AND LOW LEVEL EFFECTS OF IONIZING RADIATIONS (cont'd)

The AEC financed the travel and per diem of ten U. S. scientists going to the meeting. The Symposium was planned as an effort to study the basic mechanisms of radiation effects and brought together essentially all of the evidence bearing on non-carcinogenic biological effects of very low level, low intensity radiation important in consideration of fallout and reactor operations.

The Italian Atomic Energy Agency with the cooperation of UNESCO organized the Symposium. It was financially supported by UNESCO, the Italian Agency, the National Science Foundation, as well as the AEC. The general benefit to the U. S. from its participation in the meeting was the acquisition of information leading to a better understanding of the mechanism of radiation damage. It is expected that research in this field will be enhanced as a final result of the meeting.

13. CONFERENCE ON THE PRESERVATION OF FOODS BY IONIZING RADIATIONS

The Department of Food Technology, Massachusetts Institute of Technology, sponsored this Conference at the Institute during the period July 27-30, 1959. The AEC and the IAEA financially supported the meeting. The objectives of the Conference were to disseminate scientific knowledge and techniques in the field of radiation preservation of foods, and to discuss the practical means of establishing and utilizing this knowledge and technique to an economic advantage in various parts of the world.

Representatives of 15 countries including the United States participated in the Conference as panel session members. In addition, representatives of 13 other countries came to the Conference as observers or delegates of their respective countries. The total attendance was 100 scientists and technicians.

The following six points were unanimously agreed upon by participants as summarising the conclusions reached in the Conference: (1) there was sincere interest by represented countries in the present status of food preservation by ionization; (2) there was special interest by countries in the economic and engineering aspects of isotope utilization for food purposes; (3) reports of foreign representatives indicated that future plans envisaged installation of isotopic sources if not presently available; (4) expressions were made concerning the need for more numerous and extensive investigations to determine acceptance of treated products under practical institutional and home-cooking conditions; (5) a feeling was evident that decisions concerning wholesomeness are essential to rapid progress in the field; and (6) preservation of the following foods by radiation were considered significant: wheat, corn, fish, fruits, and meats.

Considering the extent of participation and the exchange of information at the Conference, the meeting was determined to be successful.

14. CONFERENCE ON SOLID STATE PHYSICS

The Australian Institute of Physics sponsored this Conference in Melbourne, Australia during the week of August 17, 1959. The meeting was the first international conference in this field held in Australia. Two important objectives were envisaged in the Conference planning. First, people from other countries would be given the opportunity to observe what was being accomplished in solid state physics in Australia. Second, Australian science would be assisted in combating the feeling of isolation on the part of Australian scientists. The Conference was very successful in achieving both objectives.

The total number of registrants at the Conference was 136. The large majority of these persons were Australians and New Zealanders, but there were included 8 representatives from the United States, 3 from Great Britain, and 1 from Canada. A total of 46 papers were presented at the Conference including 8 by the United States. From all comments by the Australian scientists, it can be concluded that the Americans made a favorable impression. It was remarked that the papers presented by the Americans were all of high quality and made important contributions.

The chief benefit derived by the United States was a marked gain in prestige. Although the Australians gained considerably from the U. S. participation, the U. S. gained an appreciation of the Australian efforts in the field of solid state physics.

15. FIRST INTERNATIONAL OCEANOGRAPHIC CONGRESS

This Congress was the first meeting to bring together representatives of all the scientific disciplines interested in the ocean and seas. It was convened at the UN Headquarters in New York City from August 30 through September 11, 1959. The Congress was arranged by the American Association for the Advancement of Science and was co-sponsored by UNESCO and the Special Committee on Oceanic Research of the International Council of Scientific Unions.

Approximately 1,175 persons registered for the Conference and 53 foreign countries were represented. There were a number of organizations which contributed financially to this meeting in addition to the AEC, namely, UNESCO, Office of Naval Research, National Science Foundation, Rockefeller Foundation and several industrial firms. The AEC financial support was used to pay for a share of the costs relating to secretarial services and the publication of proceedings.

15. FIRST INTERNATIONAL OCEANOGRAPHIC CONGRESS (cont'd)

Some of the topics which appeared to be of the greatest interest and importance were: Mid-ocean Rift, The Origin of Life, The Origin of Fossils, Biological Location of the Equator, Exotic Animal Forms, Biological Mapping of the Ocean, Ocean Currents, and Oceanographic Equipment. The AEC had particular interest in the sessions dealing with distribution of pelagic sediments and nuclear processes in pelagic sedimentation.

There was free and open discussion with presentation of substantial amounts of new information and discussion of new hypothesis. The foreign visitors contributed substantially to these discussions. Qualitatively, the advantages were the same to participants from all countries, but quantitatively, the majority of participants were from the United States; and, therefore, the total benefit from the Congress presumably was greater to the U. S. than to other countries.

16. INTERNATIONAL SYMPOSIUM ON THE CELL NUCLEUS

The Faraday Society sponsored an International Symposium on the Cell Nucleus held at Cambridge, England, August 31 and September 1, 1959. The meeting was attended by 75 scientists who specialize in research on the Cell Nucleus. The USAEC supported the Symposium by financing travel and per diem of 8 U. S. participants.

The U. S. scientists were from the National Laboratories of Oak Ridge, Argonne, and Brookhaven. Each individual presented a paper in his area of specialization. The Symposium was comparatively small for an international meeting, and the attendees were easily accommodatedin one lecture hall of moderate size. This arrangement resulted in an informal atmosphere with a good flow of discussion. Topics discussed included functions of the nucleolus, biochemical and radioautographic studies, nuclear enzymes, and the structure of chromosomes as revealed by electron microscopy.

In the opinion of those attending the Symposium, it was regarded as quite informative, and it was believed that such meetings should be held regularly. The informal and free exchange of scientific information benefited the U. S. scientists in pursuing the future research in the area of the Cell Nucleus.

17. XXIst INTERNATIONAL CONGRESS ON PHYSIOLOGICAL SCIENCES

The International Union of Physiological Sciences sponsored the XXIst International Congress on Physiological Sciences held in Buenos Aires, Argentina August 9-15, 1959. The U. S. National Academy of Sciences coordinated the U. S. participation for this meeting. The AEC and the National Science Foundation were the principal U. S. Government agencies supporting this meeting. AEC funds were used to finance the travel and per diem of 18 selected U. S. scientists.

The scope of the meeting encompassed a series of symposia covering a number of subjects of programmatic interest to the AEC. It is important to note that in addition to the AEC support, other government agencies supported this Congress to the extent that a total of 50 selected U. S. scientists attended the meeting.

The Buenos Aires Congress was the first of its kind to be held in South America and afforded opportunity to physiologists, pharmacologists, from many countries to exchange information, provide stimulation to research, and enhance international relations particularly by the U. S. and South American countries. In this regard it was felt that a good representation from the U. S. was essential to the success of the Congress. It has been reported that the AEC presentation in this Congress successfully accomplished the objectives cited above.

18. INTERNATIONAL CONFERENCE ON APPLICATION OF LARGE RADIATION SOURCES IN INDUSTRY

The International Atomic Energy Agency sponsored an International Conference on the Application of Large Radiation Sources in Industry held at Warsaw, Poland during September 8-12, 1959. This Conference was the first major scientific conference sponsored by the IAEA and was also their first to be held behind the "Iron Curtain".

There were 173 participants at the Conference representing 26 countries and 4 international organizations. The IAEA was represented by the director general and both deputy directors general as well as other IAEA officials. The U. S. was represented by 30 participants and of these 21 were financially supported by the AEC. Representation from other principal IAEA Member States was as follows: France - 20, United Kingdom - 15, Germany - 16, and USSR - 7.

The Conference agenda included topics such as: Large Radiation Sources and Methods of Use; Use of Nuclear Reactor Fission Fragment Recoil Energy; Radiation Initiations of Polymerization and Chemical Reactions; Food Preservation; and Radiation Processing Economics. A total of 61 papers were presented at the meeting of which 17 were by the U. S.

The value of the Conference to the U. S. was the opportunity afforded for leading U. S. experts in radiation applications to consult freely, informally and in detail with equal active colleagues throughout the world. The U. S. also demonstrated that its progress was equal to or possibly ahead of other nations in radiation chemistry and on a par in laboratory research and development on practical radiation applications. The Conference revealed, however, that the U. S. is behind in industrial-type isotopic irradiators. Such irradiators are in operation or under construction in France, United Kingdom, Australia, and the USSR.

In summary, there was general acknowledgement at the Conference that the development of industrial radiation is a long—range program. The participants felt that the economic promise of radiation application is great, but no immediate returns should be expected. Economical justification was not considered an appropriate gage as yet of desirable levels of investment in radiation research and development. The U. S. by the quality and quantity of its participation effectively emphasized its strong support of the IAEA.

19. THIRD ANNUAL INTERNATIONAL SYMPOSIUM ON RADIOCHEMISTRY

This Symposium was sponsored by the Japanese Chemical Society and was held in Shizuoka City, Japan during October 8-10, 1959. It was attended by approximately 300 scientists working in the field of radiochemistry.

The U. S. was invited to participate at this meeting and responded by sending one representative. The meeting was of programmatic interest to the AEC particularly the Division of Research.

Seventy-three papers were presented, most of which represented the great interest of Japanese radiochemists and may be grouped generally under five headings:

(1) development of new analytical techniques for specific isotopes;

(2) the measurement of fallout;

(3) activation analysis and its applications;

(4) low energy nuclear reactions

(5) hot atom chemistry.

There were no high-energy radiochemical papers included because of the complete lack of high energy bombardment facilities in Japan. It is important to note that the U. S. participant was the only author of a paper who was not Japanese. This participant reported that one special advantage of participation

in Japanese conferences is to exchange information with the Japanese who occupy the leading position in the field of Far Eastern chemistry. It is felt that the exchange of information on sub-groups of radiochemistry; such as, activation analysis, low energy nuclear bombardment, and hot atom chemistry can be especially beneficial to the U. S.

20. INTERNATIONAL SYMPOSIUM ON BIOENERGETICS

This Symposium was sponsored by the Brookhaven National Laboratory and supported primarily by the Atomic Energy Commission. It was held at the Brookhaven National Laboratory, October 12-16, 1959. The principal purpose of the Commission in supporting this Symposium was to stimulate research in bioenergetics, an area of considerable programmatic interest to the Division of Biology and Medicine.

The Symposium was designed to provide (1) a careful specification of the general problem in bioenergetics and (2) to obtain a biologically-oriented cataloging of available information. The Symposium appeared to be a success in carrying out these objectives. Forty papers were presented at the Symposium and will form the publication of proceedings of the meeting. Eight of these papers were prepared by foreign experts in the field representing England, France, Germany, India, Norway, and Sweden.

Agenda topics were enthusiastically discussed covering the area of bioenergetics which has been a promising but relatively neglected research area in the past. There were 140 participants registered for the Symposium and this included 12 foreign guests. Foremost among the benefits derived from the Symposium was the fact that at least three AEC contractors indicated that they plan to re-orient their research programs to incorporate ideas expressed at the Symposium.

21. SYMPOSIUM ON HIGH TEMPERATURE TECHNOLOGY

Stanford Research Institute sponsored an International Symposium on High Temperature Technology which was held at Asilomar, California during October 6-9, 1959. This meeting was financially supported by a number of U. S. government agencies as well as by 12 organizations of private industry. Approximately 610 persons registered for the Symposium including 12 representatives from foreign countries. The total number also included speakers, members of the advisory and conference committees and official representatives of Stanford Research Institute and of the supporting organizations.

In addition to the AEC, this Symposium was supported by the Air Force, Office of Scientific Research, Naval Research, National Science Foundation, and the Office of Ordnance Research.

The technical content of the meeting was considered to be of high caliber, and it was the consensus of those attending that the material presented was particularly significant to the scientific community in the United States. The meeting provided sufficient opportunity for the interchange of scientific information by leading scientists who were in attendance. It was tentatively proposed that the next High Temperature Symposium take place in Asilomar in 1963.

22. SYMPOSIUM ON RADIOISOTOPES IN THE BIOSPHERE

This international symposium was conducted at the University of Minnesota's Center for Continuation Study during October 19-23, 1959. Approximately 400 individuals attended the Symposium including 6 foreign scientists representing 5 countries. This Symposium was supported by the National Science Foundation as well as the AEC.

The Symposium was considered most timely and important because of the recently reported SR-90 contents of the Minnesota wheat samples. For the first time since fallout became a world-wide problem, scientists of other countries met with scientists of the U. S. to exchange information on the effect of fallout on the biosphere. The exchange of information was important to the U. S. because so much pertinent information of other countries was not well known to the U. S. scientists. As a result of the Symposium a channel was created for U. S. scientists to receive information, and to disseminate information to interested scientists of the world.

The general consensus was that the Symposium was of a high caliber and that all papers presented were most significant to the question of fallout. Subsequent to the Symposium, dozens of requests have been recived from scientists throughout the world for copies of papers presented at this Symposium.

CONFERENCES SUPPORTED UNDER SECTION 419 MUTUAL SECURITY ACT, 1954, AS AMENDED

1. THE FIRST INTER-AMERICAN SYMPOSIUM

This Symposium, organized by the AEC with the assistance of the Department of State, International Cooperation, and the Organization of American States, was convened in May, 1957, at the Brookhaven National Laboratory. It was attended by 235 participants of whom 116 were from the United States.

The agenda for the Symposium included topics for discussion and papers concerned with the areas of management of an atomic energy program; legal and administrative problems related to atomic energy; relationship of atomic energy to the physical and life sciences; and nuclear technology. There were some small technical exhibits at the Symposium which supplemented the scientific and technical papers which were presented at the meeting. Also, there was an extensive display of books, reports and pamphlets which were available at no cost to the Latin American participants. Copies of the eight-volume set of selected reference material, which was prepared for the Geneva Conference in 1955, were given by the AEC to all participants from Latin America. A book allowance of $25 was also given to each of these participants by the ICA. Following the sessions at Brookhaven, the Latin American participants were provided two week tours of AEC and other government facilities, universities, hospitals and a few industrial establishments engaged in peaceful nuclear research.

It has been reported that the Symposium laid a groundwork for the newly established Inter-American Nuclear Energy Commission which gives hope for a coordinated plan for nuclear energy in Latin America.

2. THE SECOND INTER-AMERICAN SYMPOSIUM

The Second Symposium, organized by the Organization of American States with assistance from the AEC, was convened in Argentina at the Medical School of the National University of Buenos Aires during June, 1959. Its subject matter was confined to the areas of research on the uses of radiation and radioisotopes in the biological, medical and agricultural sciences.

Attendance at the Symposium included 150 registrants, of whom 70 were from Argentina, 66 from other Latin American countries, and 14 from the United States. Participants presented 32 papers of which 12 were by U. S. representatives. The papers and discussion topics covered the uses of radiation and radioisotopes in the areas of botany, zoology, insectology, radiobiology, agriculture, and medicine.

One of the outstanding features of the Symposium was the active participation by representatives of Latin American countries. They discussed their work and mutual problems freely, and created an informal atmosphere for the exchange of information and ideas. There was a strong indication that future symposia are desirable in Latin America.

3. INTER-AMERICAN SYMPOSIUM ON LEGAL AND ADMINISTRATIVE PROBLEMS IN A NUCLEAR ENERGY PROGRAM

This Symposium was sponsored by the University of Puerto Rico and the Pan American Union with the cooperation of the United States Atomic Energy Commission and was held at San Juan, Puerto Rico during November 16-19, 1959.

The meeting was attended by 25 participants from Latin American countries, 2 from Canada, and 25 from the United States. Representatives of the Puerto Rican Nuclear Center, the University of Puerto Rico, and The Commonwealth Government were also in attendance.

54953 O—60—vol. 2——12

The program included discussions on the nature and uses of nuclear materials and facilities; safety problems associated with wide-spread use of radiation sources; government activities to protect against radiation hazards; liability; legal framework for atomic energy programs; international cooperation; and special problems of Latin American countries.

It has been reported that the U. S. presentations were of high caliber and contributed substantially to the success of the meeting. It was further believed that the papers presented by all participants should provide a worthwhile publication of proceedings and make a valuable contribution to the Atoms for Peace program.

4. INTERNATIONAL ATOMIC ENERGY AGENCY - CONFERENCE ON DISPOSAL OF RADIOACTIVE WASTES

The IAEA sponsored this International Conference in the Principality of Monaco during November 16-21, 1959. The Conference was one of two major meetings organized by the Agency in 1959 and because of the wide-spread interest in its subject matter, it was co-sponsored by UNESCO with assistance from the Food and Agriculture Organization of the United Nations.

There were 65 papers presented by representatives of Member States of the IAEA, and of this number 22 were given by U. S. scientists. It has been reported that the U. S. papers were outstanding in detail and technical content.

Five days of technical meetings were held covering all aspects of radioactive waste disposal, from the nature and magnitude of radioactive waste disposal to methods of treatment and disposal of the waste into the sea and geological struct

One of the features of the Conference was the heavy emphasis on oceanography and marine biology. A number of papers described the dilution of radiactive wastes in sea water and the uptake of various fission product species by marine biota. Various methods of disposal of radioactive wastes into geological structures were also discussed. Those included injection into deep wells, storage in porous rock, storage in salt domes, and storage in salt mines. It was generally concluded that a great deal of study of specific geological environment was required in order to establish confidence that radioactive wastes may be safely stored.

It was believed by conference participants that the proceedings of this meeting will prove valuable in any attempt to reach an international agreement on methods of disposal of radioactive wastes into the public waterways of the world.

LETTER OF TRANSMITTAL FROM ATOMIC ENERGY COMMISSION

In one of your letters dated November 20, 1959, you requested a background paper on the "Training and Education Programs of the United States."

I am happy to enclose with this letter * * * a report on this subject prepared by the Commission's Division of International Affairs.

INTERNATIONAL TRAINING PROGRAMS OF THE ATOMIC ENERGY COMMISSION

A. Summary

"The speed at which the peaceful uses of atomic energy develop will be controlled by . . . . . the availability of people having proper knowledge and equipped with adequate facilities and the availability of well qualified, highly trained scientists, engineers and technicians to carry forward research, development, design and construction of atomic plants and devices."

The above summary on manpower and training needs of the atomic age was made by the Panel on the Impact of Peaceful Uses of Atomic Energy in its report to the Joint Committee on Atomic Energy in January, 1956. It had particular significance in the area of international cooperation and by that time, training in the United States of qualified students of friendly nations had become one of the major efforts of the U. S. Atoms for Peace Program.

Since then, the international training program of the AEC has grown in scope and size and has been kept flexible to meet special needs of foreign countries as they materialize. In addition, as the capacity of colleges and universities to provide training in the nuclear field has grown the Commission's program has been oriented more and more to specialized training which utilized the unique facilities or experience of Commission installations.

A small beginning had been made even under the limited international exchanges permitted under the 1946 Atomic Energy Act. Between 1948 and 1954, some 40 students from other countries received the basic training in radio-isotope techniques given at the Oak Ridge (Tennessee) Institute of Nuclear Studies, a Commission-supported institution.

By the end of 1959, more than 2,500 from 70 nations had completed or were receiving formal instruction or on-the-job training in facilities of the Commission and its contractors.

An undetermined additional number, believed to at least equal this figure, had been or were enrolled in undergraduate and graduate work at educational institutions within the United States or had received special training in the plants and laboratories of private U. S. firms engaged in international atomic energy trade. For example, Italian engineers who will operate the 150 MWE nuclear power plant to be built in Southern Italy by an American firm will be trained in the U. S. plants and reactor facilities of the American company.

Formal courses now are open to qualified students from friendly countries in the following six AEC or contractor facilities:

The Oak Ridge Institute of Nuclear Studies; The International Institute of Nuclear Science and Technology at Argonne National Laboratory, Lemont, Illinois; The Oak Ridge National Laboratory, (Oak Ridge, Tennessee); The AEC Health and Safety Laboratory, New York City; The Puerto Rico Nuclear Center operated at Mayaguez, Rio Piedras and San Juan by the University of Puerto Rico and the Shippingport site at Shippingport, Pennsylvania, where the first full-scale nuclear reactor in the United States devoted exclusively to production of power has been in operation since 1957. Enrollees from other countries in these courses generally are sponsored by their respective governments. In many cases, financial assistance to students has been given

through funds available to the Department of State and the International Cooperation Administration.

In addition to the formal courses the USAEC has maintained an extensive program to place foreign nationals on a case by case basis at Commission installations or other institutions for specialized research and training. Extended visits of scientists from abroad to AEC laboratories and research centers began on a modest scale prior to 1954 but the level of this type of activity has been greatly expanded since then. These visitors often work side by side with American scientists on unclassified research projects and many have made valuable contributions to the work of our laboratories during their stay. Arrangements for these in-service programs often are made on an individual basis by the laboratory, with approval by the AEC.

The United States also has undertaken to send a significant number of its own technical personnel overseas to participate in, and assist foreign programs. As other nations have developed their own program facilities, there has been an increasing demand for U. S. scientists and engineers to lecture abroad and work at these new institutions. These arrangements have contributed to the development of nuclear programs overseas, have frequently been of technical interest to the USAEC and have established useful friendships for the United States and its scientific community. The number of such exchanges is expected to increase in the future.

Lastly, for the past two years, the United States also has provided approximately 120 fellowships to the International Atomic Energy Agency for training in this country. The Agency's fellowship program has been notably

successful and has figured importantly in training personnel from all over the world in the fundamentals of nuclear energy. It is noteworthy that more applicants for IAEA fellowships have indicated a greater preference for training in the United States than in any other country.

In order to obtain an accurate assessment of the value and usefulness of its training programs the Commission has made continuous efforts to follow the development of nationals trained in its installations to determine whether their acquired skills were being utilized in the nuclear programs of their governments. Many of those who have completed various types of training in the United States now hold positions of leadership in the nuclear energy programs, universities and industries and research centers in their home countries. For example, more than 125 graduates of the International School of Nuclear Science and Engineering (predecessor to the present Institute) and of the radioisotopes techniques courses at the Oak Ridge Institute of Nuclear Studies attended "class reunions" held in Geneva, Switzerland, in September, 1958 during the United Nations Peaceful Uses Conference. Many were delegates to the Conference and several presented scientific papers. Appendix A is designed to provide some specific indication of (a) the manner in which much of the training received in the U. S. is now being utilized by foreign nationals and (b) the effectiveness of the over-all foreign training effort.

In the following sections of this paper, the salient facts concerning the major training programs of interest to the international program are described in further detail.

OAK RIDGE INSTITUTE OF NUCLEAR STUDIES--ORINS is an association of 37 southern universities under contract with the United States Atomic Energy Commission. The Special Training Division of ORINS offers specialized courses of instruction in the uses of radioisotopes which are designed for scientists and engineers, physicians, industrial personnel and college and university science professors. Besides handling U. S. trainees, these courses have been available to foreign nationals since 1948 during which time students from over fifty countries have been represented. In addition, since 1955 a quota of thirty percent of the Institute's trainee capacity has been available to aliens.

Depending upon the participant's individual interest and need, an ORINS training program usually lasts from four to six weeks, through a series of courses that range from basic instruction in fundamentals of radioisotope techniques to more specialized instruction in radioisotope applications in various scientific disciplines. The course series usually available is as follows, listed in the order of increasing complexity:

a. Basic Radioisotope Techniques: This is a two-week course which can accommodate a total of 72 participants and provides an introduction to the properties of radioactive materials and their radiations and the techniques of safely using radiations as additional tools in scientific pursuits. Upon completion of this course participants have the option of continuing their studies in either course (b) or (c) below, which are presented concurrently.

b. Radioisotopes Techniques in Industry: This two-week course emphasizes the techniques for utilizing radioisotopes in research and development activities and industrial applications. Much of the time is devoted to actual work in the laboratory. Experiments include using radioactive tracers to determine the uniformity of mixing, measuring radiation effects, quality control studies, familiarization with many types of radiation detection and measurement systems.

c. Radioisotopes Techniques in Research: The course content for this two-week session is similar to that of (b) above except that it is slanted toward research studies.

Graduates from this course and its counterpart in industrial applications (item b) have the further option of continuing study for another two weeks in more specialized industrial and research techniques. A total of 24 participants can be accommodated in this course.

More than 350 foreign nationals have completed one of the ORINS courses as of December 31, 1959. (See Table I.) Many of these graduate trainees have returned to their homelands with a broader knowledge and with new techniques which have extended the range and scope of their prior capabilities in their respective scientific pursuits. Illustrative information on how these students are applying their skills in their own national nuclear energy programs may be found in Appendix A.

A nominal fee of $25 to cover registration costs is paid by each participant for any continuous enrollment period. Participants are housed in local hotels.

Estimated cost for subsistence and lodging is approximately $75 per week, depending on accommodations desired.

INTERNATIONAL INSTITUTE OF NUCLEAR SCIENCE AND ENGINEERING: In 1954 and 1955 the United States initiated a sizeable program to disseminate information on the peaceful uses of atomic energy overseas, and to assist other countries develop their own nuclear programs. At the outset, it was recognized that the provision of suitable training facilities would be fundamental to the programs success and accordingly, in outlining the specifics of the initial "Atoms for Peace" program to the United Nations in November 1954, Ambassador Lodge indicated that the U. S. was prepared to establish a basic reactor training school which would be open to foreign nationals.

As a result, the International School of Nuclear Science and Engineering at Argonne National Laboratory was established in March 1955 to provide training in the fundamental aspects of nuclear science and technology. This type of training was generally not available at that time outside the few Commission-sponsored programs which were designed to train U. S. personnel working in AEC installations. The School's program was specifically oriented to satisfy the diverse backgrounds of students from various foreign countries.

Beginning in the third session the students were sent to either North Carolina State College at Raleigh, North Carolina, or Pennsylvania State College at University Park, Pennsylvania, for training in a university atmosphere. The six months spent at these schools was designed to provide the participants with appropriate basic training in fields related to nuclear science and engineering.

Upon completion of these six months, the students then went on for at least four additional months training at the International School.

Following its establishment, and over a five year period, the International School made notable contributions to the development of nuclear programs throughout the world and it provided training opportunities that were not readily available elsewhere. Over 500 foreign nationals representing 45 countries were trained (see Table II), the School's program was generally well-received, and many of the foreign nationals who were trained went on to distinguish themselves in their own national programs. It should be noted that efforts have been made to keep abreast of the development of the School's foreign alumni and it appears that nearly all are now engaged in, or have firm plans for, pursuing careers in the nuclear field. Appendix A to this paper, for example, contains a representative list of the present occupations of 65 alumni.

As the program developed an increasing number of applicants for the course demonstrated that they had been able to obtain the type of preparatory training provided at North Carolina State College and Pennsylvania State College in their own countries. This factor together with an increasing competence of several American universities to provide the required basic training motivated a reorganization of the School's program.

Specifically, it was decided to dispense with the specialized preparatory training at North Carolina and Pennsylvania on the assumption that adequate facilities were available to provide this training at many universities, raise the minimum entrance requirements to a Masters degree or the equivalent, and

reorient the program so as to provide, in general, more advanced training centered around the unique facilities and programs at the Argonne National Laboratory. To reflect this reorientation, the International School's program was revised and its name changed to "The International Institute of Nuclear Science and Engineering."

The first session of the Institute began in February 1960 and there are five program areas now available: (1) Training in Reactor Science and Technology: which is designed to qualify appointees for instructional positions or as members of teams charged with the general responsibility for the design and development of reactors. (2) Engineering Research and Development Training: which is designed to qualify individuals for specialized work in one or more of the areas of nuclear engineering. (the specific seminar and laboratory topics in engineering research and development vary from session to session as the work of the Argonne National Laboratory advances.) (3) Physical Science Research: which offers work with members of the Argonne staff on research problems utilizing the unique facilities of the Argonne National Laboratory. Seminars are offered in several fields varying from term to term as new interests and programs develop. (4) Life Science Research: This sequence offers the exceptional facilities of the Laboratory to fully qualified scientists in (a) biochemistry, (b) plant and animal physiology, (c) radiobiology, and (d) cancer research. Seminars are conducted on recent advances in radiation biology, cellular radiobiology, and effects of radiation. (5) Engineering, Administration and Operation of Nuclear Facilities: This program is designed to assist in establishing sound procedures for the operation of

nuclear facilities. Representative topics included are radiation safety, storage and disposal of radioactive material, monitoring for radioactive material, operational procedures for reactor facilities, reclamation of contaminated space and equipment, as well as the design and construction of facilities for nuclear science and engineering experiments.

Two types of appointments to the Institute now are available:

(a) The Participant Appointment which is intended for those individuals with a master's degree of the equivalent who will work as members of engineering and development teams charged with the responsibility for the design, construction or use of nuclear facilities, as well as for those who expect eventually to assume responsibilities for the administration of such facilities. Teachers who expect to conduct classes in nuclear science and engineering also should find many aspects of the participant program advantageous. (Participant appointments are available in the areas of Reactor Science and Technology, and Engineering Research and Development, for one or two terms, and in the area of Engineering, Administration and Operation of Nuclear Facilities for one term only.)

(b) The Affiliate Appointment which is intended for highly experienced applicants with doctoral and post-doctoral experience who have established themselves in research careers in nuclear science or related fields. Affiliate appointments are available for research in the program areas 3 and 4 listed above, as well as for applied research and development in the science and technology of reactor systems, and in the various areas of nuclear engineering. Affiliates do not necessarily follow a formal program of lectures and laboratory

work during the period of their appointment. Based on their prior training, experience and specialized interests, they are expected to begin their research projects shortly after arrival at the Institute. Advanced seminars and possibly special experiments may be organized to assist Affiliates in acquiring more detailed knowledge of particular topics. Restrictions imposed by space, equipment, and staff time, limit the number of these appointments.

The International School benefited from its ability to train students on some of the extensive, and often unique, facilities available at the Argonne Laboratory. The new Institute has this same advantage. Examples of these facilities are as follows:

1. Argonne Naught Power Reactor (Argonaut) - flexible low-power training and research reactor.
2. Solid Homogeneous Reactor (AGN-201) - 0.1 watt training reactor, using solid homogeneous fuel.
3. Argonne Research Reactor (CP-5) - 1000 kilowatt, heavy-water moderated reactor.
4. Experimental Boiling Water Reactor (EBWR) - direct-cycle 20,000 kilowatt research reactor.
5. Several exponential assemblies.
6. Several reactor simulators.
7. Chemical reprocessing pilot plant.
8. In-pile heat transfer loops, using both water and liquid metal.
9. Hot cells.

10. Cryogenics equipment.

11. Metallurgical laboratories.

12. Massive gamma radiation sources.

These facilities are available to all assigned in the programs for training in reactor science and technology, engineering research and development, physical science research and operation and administration of nuclear facilities.

Lastly, the students who participate in life science research have extensive equipment for gamma irradiation, use of isotopes, and experimental therapy.

The estimated costs per term, at the Institute including expenses for medical insurance and for possible field trips to other AEC installations are as follows:

Tuition (for participants)	$1,000.00
Food, Housing, and Miscellaneous Living expenses	1,450.00
Trips	300.00
Total ——	$2,750.00

Transportation to and from the Institute must be arranged by the appointee or his sponsoring organization.

Affiliate appointments require no tuition payment, since Affiliate contributions to the Laboratory's programs are expected to offset any tuition charge.

OAK RIDGE NATIONAL LABORATORY SPECIAL TRAINING COURSES

Nuclear Reactor Operations Supervision Course: This 9-month course was first presented in February 1959 at the Oak Ridge National Laboratory. The curricula describes and emphasizes the various responsibilities of a supervisor

for an operating reactor who must be able to perform and is designed to equip qualified students with the technical competence they would need to assume these responsibilities. For this reason, the program provides experience in the operation of various ORNL reactors coupled with instruction in course material on such matters as reactor operations, health physics, and instrumentation and control, which are designed to present the scientific and engineering principles of research reactors and their associated machinery. Up to ten foreign nationals are permitted to attend.

Nuclear Reactor Hazards Evaluation Course: This course was initiated in February 1959 and uses the same faculty and physical plan at the ORNL as the reactor supervision course described above. The hazards evaluation course, however, is of 12 months duration, and emphasizes the development of the students ability to evaluate the many hazards of reactor operation, including those associated with criticality. These hazards range from those involved in the geographical and geological environment of a reactor site to accidents that are possible from a chance conjunction of unlikely events. Once the student has a sufficient understanding of reactors, he is given the opportunity to apply existing techniques and to help develop additional ones in the field of hazards evaluation. The student ceiling for this course is sixteen which, to date, has been comprised almost entirely of foreign nationals. (See Table IV.)

The tuition fee for all students is $2,000 for either of the special programs. There are no additional charges for the use of reference books, textbooks, materials, supplies, and equipment made available for student use.

A minimum income of $300 per month covers living expenses for a bachelor using public transportation between Oak Ridge and the Laboratory, dormitory charges, and meals. This estimate makes some allowance for minor incidental expenses.

PUERTO RICO NUCLEAR CENTER: The Puerto Rico Nuclear Center was established in 1957 by the AEC as part of the "Atoms for Peace" program, to carry forward the proposal made by President Eisenhower at the 1956 Panama Conference that work be initiated to "... hasten the beneficial uses of nuclear forces throughout the hemisphere, both in industry and in combating disease." The Hispanic environment of the Center was designed to facilitate participation by students from the Latin American States; however, qualified students from other countries are accepted. The activities of the Center are generally bilingual, but all formal lecture courses are in Spanish. The objective is to provide training and research programs in the application of nuclear energy to the fields of agricultural, biological, medical, nuclear engineering, and physical sciences.

This training and research center is operated by the University of Puerto Rico under contract with the AEC. When completed, the major physical facilities provided by the AEC will include a swimming-pool-type research reactor, an associated laboratory, and a biomedical research center building. The reactor will be completed by about September 1960, the biomedical research building early in 1961. In the interim, the Center is operating in temporary quarters on the University of Puerto Rico campus at Mayaguez and at Rio Piedras.

There has been installed and put into operation a small homogeneous training reactor. The curriculum in nuclear engineering technology includes courses in

reactor theory and operation. This type training is necessary for the design, development, testing, and operation of nuclear reactors. Completion of the training affords an opportunity to attain the degree of Master of Science in Nuclear Technology.

Medical training and research programs and facilities for studying medical applications of radioisotopes and nuclear radiation have been developed jointly by the Commission and the School of Medicine of the University of Puerto Rico. The medical programs concentrate on the applications of radioisotopes and the effects of radiation as studied and utilized in basic or preclinical medical science, in clinical medicine, and in the specialized field of radiotherapy and cancer treatment.

A four-week training course in radioisotope techniques patterned after the course presented by the Oak Ridge Institute of Nuclear Studies also is offered every other month. All necessary facilities, including an excellent radiochemistry and counting laboratory, are available for this course.

The great amount of effort required in the design and operation of a nuclear facility to insure adequate protection to personnel, materials and the public against the effects of ionizing radiation is often completely overlooked or given a dangerously low priority. Such a situation is usually remedied by having on hand people trained to think in terms of nuclear hazards. In an effort to assist with this problem, courses in Radiological Physics and Radiation Safety Techniques have been established at the PRNC. A one-year curriculum in Radiological Physics provided fundamental knowledge in nuclear physics and biophysics, interaction of radiation with matter and living systems, dosimetry,

instrumentation, and the principles of permissible exposure and prevention of undesirable exposure. The student is also introduced to some of the legal and public relations aspects of radiation protection.

The Radiation Safety Techniques Course is of three months duration and is offered to acquaint personnel with accepted levels of ionizing radiation, radiological techniques, and radiometric equipment. The trainees are presented procedures for the proper and safe handling of equipment, and protection of personnel utilizing x-rays and radiation sources in medical laboratories, offices, university departments, and other institutions.

Table V contains a compilation of the PRNC enrollment by fiscal year and country.

For most study and training programs in the Nuclear Center, the total charges for tuition and fees are $6.25 per credit hour, or $6.25 per week for full-time non-credit programs. For certain special programs, higher fees may apply.

Housing or living accommodations on campus are limited. Estimated rates for room and board vary from $55 to $65 per month. Travel and incidental expenses are additional.

RADIOCHEMICAL AND COUNTING PROCEDURES COURSE: During the first session of the United Nations Scientific Committee on the Effects of Atomic Radiation, held in New York, March 1956, considerable interest was expressed by the representatives of the Member States in the procedures followed by the United States in the collection and analysis of fallout samples. On June 13, 1956, Ambassador Lodge

offered technical assistance to these countries in the measurement of radioactive fallout.

As a consequence, there was developed at the Commission's Health and Safety Laboratory at New York a six-week course in the techniques for radiochemical and instrumental analysis for evaluation of radiation through fallout. The program consists of lectures and discussions coordinated with practical laboratory experience, affording an opportunity to solve actual problems in the measurement of radioactive isotopes occurring in fallout. This course is currently offered three times a year. To date, five courses have been given, and Table VI gives the number of foreign participants that have attended the five sessions and the countries they represented.

A registration fee of $25 is charged each participant. Costs for travel and living expenses are borne by the student or his sponsoring government or institution. A minimum estimate for housing, living, and incidental expenses is $350 for the six-week period.

NS SAVANNAH COURSES: In October 1956, President Eisenhower announced that the United States would construct a nuclear merchant ship to demonstrate the peaceful application of atomic energy to commercial ship propulsion. He indicated that all information developed in the construction of the NS SAVANNAH would be unclassified and would be made generally available.

Two training programs known as the NS SAVANNAH Construction Observation Program at Camden, New Jersey, and NS SAVANNAH Reactor Engineering Officers' Training Course at Lynchburg, Virginia, then were developed.

Under the Camden course (which is still in existence) selected foreign

engineers were afforded the opportunity to observe the construction of the NS SAVANNAH, and their access to the site was limited only by the construction requirements placed on the contractor, (the New York Shipbuilding Corporation).

Under the second arrangement, the Babcock and Wilcox Company of New York City was selected to train the licensed engineering officers of the vessel on how to operate the reactor at the Babcock and Wilcox plant in Lynchburg, Virginia. Arrangements also were made for a limited number of foreign nationals to enroll in this reactor operators' course. This course began in April 1959 and lasted ten months.

While the Lynchburg course trained engineering officers in the operation of the reactor, the Camden course covered the engineering, supervision of construction, the examination of construction specifications, and plans in conjunction with actual observation of the ship's construction, and the participants were able to review in detail all pertinent documents relating to hull design, collision barrier design, reactor compartment, containment vessel, secondary and primary shielding, machinery, equipment design and materials, secondary system, reactor and primary system, instrumentation and control and safety.

Over 30 foreign nationals representing 9 countries will have attended both the courses as of February 1960. (See Table IV.)

An estimated expenditure of $900 is made for the 11-week course. All costs of travel, lodgings, subsistence, and miscellaneous expenses during the period are borne by the participant or sponsoring government or institution. A per diem rate of $12 is suggested.

SHIPPINGPORT NUCLEAR POWER STATION TRAINING COURSE: The Shippingport Nuclear Power Station at Shippingport, Pennsylvania, is a full-scale nuclear-powered plant and as such it was the first sizeable nuclear power plant to have been placed in operation in the United States. The plant organization has served as a valuable pattern for the establishment of operation forces for future nuclear power stations, and the facility itself has been of great value in providing training for personnel for future plants. The plant has been of considerable interest to various foreign nuclear energy organizations.

Therefore, under direction from the USAEC, a training program was established for technical supervisory personnel of American and foreign organizations who were working with the design, construction and/or operation of future nuclear power plants.

The first course started February 9, 1959, with four foreign nationals included in the group of trainees. Primary emphasis in the first phase of training was directed toward the knowledge required for understanding the plant characteristics, control and instrumentation, operation and safety, and, in general, was applicable to different reactor types.

After completing classroom instruction, the students were assigned to the Shippingport operations and maintenance staff for approximately three months. This training consisted mainly of reactor operations to be performed by each student, coupled with a study of the operating plant.

The nuclear power station was shut down for refueling in July 1959. A second course of 4-month duration was then established to provide training in areas such as maintenance, health physics, chemistry, instrumentation, radioactive

chemistry, and test analysis. As far as practicable, training assignments were in accordance with the participants' job classifications and their sponsors' desires. There were four foreign nationals in attendance. A new course is scheduled for April 4, 1960, and additional courses will be offered every four months thereafter as the demand warrants. (See Table VIII.)

The tuition for the course is $2,000 for the 4-month term. A per diem rate of $12 is suggested as sufficient to cover transportation, lodgings, subsistence, and miscellaneous expenses. Travel expenses are borne by the participant or sponsoring government or institution.

INDIVIDUAL TRAINING

Many of the requests from foreign countries for training involve needs that cannot be met through the formal courses listed above. The Commission attempts, therefore, to arrange suitable individual programs to meet these needs. The degree of success that has been achieved in arranging such individual assignments is reflected in the fact that in the past four years, 2,500 men and women from 58 countries have had access to specialized training opportunities outside the confines of the formal training courses.

To arrange these individual programs or research opportunities, it has been necessary to draw upon the facilities of a great variety of nuclear installations under the direction of many organizations. Examples of those facilities most frequently used are:

a. National Laboratories operated by AEC contractors — in many instances the training interest involves specialized facilities available only at these large governmental centers. Often the alien participant is sufficiently skilled

to make a very real and significant contribution to the program efforts of the laboratory. Through the specialized participation of aliens in the program, the Commission has had the benefits of valuable scientific talent and the experiences of other programs that might not otherwise be available.

b. University facilities -- approximately 100 American universities and colleges today offer undergraduate and/or graduate courses in reactor theory, nuclear engineering, radioisotope practice, or other atomic energy subjects. Many of them are equipped with special facilities, such as massive radiation sources, subcritical facilities and/or training reactors. In some cases, the university programs are partially subsidized by government contracts. For example, the University of Rochester and the University of California at Los Angeles both operate medical research laboratories for the Commission.

c. Other Governmental Laboratories -- many governmental laboratories outside the AEC complex operate nuclear facilities. Examples of such laboratories which have broad research and development programs in the nuclear field are the Robert A. Taft Sanitary Engineering Center and the various laboratories of the Bureau of Standards.

d. Private Nuclear Facilities -- there are a number of independent centers with broad nuclear programs in the U. S., some of which have been established through private endowments. Examples are the Battelle Memorial Institute, Stanford Research Institute, and the Phoenix Memorial Project (part of the University of Michigan complex). This training consists mainly of reactor operations to be performed by each student, coupled with a study of the operating plant.

In conjunction with such centers and institutes, the Commission attempts to formulate reasonable individual training programs that will result in the utmost benefit to the individual and the atomic energy program of the country involved. Table VI gives some insight to the scope of such activities arranged by the AEC.

RESEARCH REACTOR AND EQUIPMENT GRANT PROGRAMS. The U. S. has provided financial grants to foreign countries for the purpose of obtaining nuclear equipment and/or research reactors. In connection with most of these grants there have been established training programs within the grant recipient country which should contribute to the ability of those countries to be self-sufficient in the nuclear energy field. The details of these programs are given in a separate report.

DEPOSITORY LIBRARIES. In order to make the nonclassified results of nuclear research and development available to all interested peoples, depository libraries have been established in 58 countries and 5 international organizations. These libraries receive all current unclassified reports on a continuing basis.

MOBILE RADIOISOTOPE LABORATORY. Two mobile training laboratories have been built by the Atomic Energy Commission and transferred to the International Atomic Energy Agency under the "Atoms for Peace" program. The laboratories permit IAEA to offer interested countries a program of training similar to the radioisotope courses given by ORINS. This enables foreign universities and research institutions to give instruction not otherwise available in the immediate locale. The mobile laboratories are designed to permit training of twelve persons in each session of normally two to three weeks.

The first unit has been used for courses in Greece, Yugoslavia, West Germany, and Austria. For the present, the second unit will be utilized mainly in the Latin American Republics.

IAEA PROGRAM FOR TRAINING AND EXCHANGE OF SCIENTIFIC PERSONNEL

As noted here and elsewhere the United States has made significant contributions to the program of the International Agency for training and exchanging scientific personnel. Inasmuch as the Agency's program has had a significant impact on the U. S. program and has been important in meeting the requirements of many nations it is summarized here in general terms.

Fellowship Program

The Agency's fellowship program was initiated in April 1958 and in the course of that year the Agency received 287 nominations for fellowships from 30 different countries. Out of these nominations the Agency selected 218 candidates to receive fellowships. As of December 31, 1959, a total of 186 of these had been accepted for study by host countries, of which 111 were engaged in training programs and 33 had completed their study. For the 1959 program the Agency received 576 nominations from 45 countries and selected 370 candidates for placement. As of this writing, 209 have been accepted for study by various countries, of which 77 were studying, and 2 candidates have completed their training.

The fellowship program provides three broad types of training:

a. Training in general techniques: to develop skill in the use of fundamental nuclear techniques;

b. Specialist training: to prepare specialists in the theoretical and experimental aspects of nuclear science, and

c. Research training: to provide advanced training, including participation in research work.

The Agency's fellowships are financed from three different sources:

a. The Agency General Fund, to which the United States contributed 50 per cent of the total.

b. Directly by Member States which have made fellowships available to the Agency program. The U. S. has donated 120 cost-free fellowships to date.

c. From the United Nations Expanded Program of Technical Assistance.

At the Agency's Third General Conference in September 1959, the United States promised to maintain its support of the 1960 training program with fellowships for Agency-selected students, and also suggested that the Agency encourage the development of an independent training capacity in more of its Member States.

Other Courses

The Agency has participated in the sponsorship of a number of important specialized training courses or seminars. For example, the first internationally organized training course in radioisotope techniques was held at Cornell University during July and August, 1959, under the joint auspices of the IAEA and the FAO. A seminar on Atomic Energy and its Educational Problems also was

held in cooperation with UNESCO at Saclay in June 1959.

Further, an international course on the Application of Radioisotopes in Agriculture and Medicine was organized jointly by the Agency and Argentina in December 1959. Lastly, a joint Agency-Government of India course on the use of radioisotopes in agricultural research was held in New Delhi in January 1960.

Exchange Program

A program of exchange of professors and scientists has also been initiated by the IAEA. Scientists have been furnished in the fields of:

a. the use of radioisotopes in medicine and agriculture (to Argentina from the U. K. and the U. S.);

b. nuclear physics (to Austria from the U. S.); and

c. radiochemistry and nuclear physics (to Japan from Australia and Yugoslavia).

In addition to the aforementioned programs, there are phases of the overall U. S. international assistance program in the nuclear energy field which contribute to the training of foreign nationals. Some of the most prominent contributing activities are listed below.

THE DOMESTIC PROGRAM

In addition to the programs outlined above, it should be noted that the United States Atomic Energy Commission also supports a substantial training program designed primarily to serve the needs of the domestic nuclear energy program. This program is of interest to this study because (a) foreign nationals may participate in some of the activities, (b) the courses involved may, in time,

be adapted to serve the needs of the foreign program, and (c) the courses are of interest to foreign countries and organizations interested in establishing programs that provide similar opportunities to their own citizens. A summary of the features of this program which are relevant to this study is contained in Appendix B.

MORE GENERAL DESCRIPTION OF RECENT RESPONSIBILITIES OF OTHERS OUT OF MORE THAN 500 GRADUATES OF THE INTERNATIONAL SCHOOL OF NUCLEAR SCIENCE AND ENGINEERING

TABLE I: ALIEN PARTICIPATION BY COUNTRY IN ORINS RADIOISOTOPES TECHNIQUES COURSE
(Excludes Immigrant Aliens - Fiscal Years 1948-1960)

Country	Number of Students
Argentina	8
Australia	2
Austria	2
Belgian Congo	1
Belgium	12
Brazil	5
Burma	1
Canada	28
Chile	1
China	5
Colombia	7
Cuba	7
Denmark	7
Dominican Republic	1
Ecuador	1
Egypt	10
El Salvador	1
Finland	4
France	1
Germany	17
Greece	14
Guatemala	4
Iceland	4
India	34
Indonesia	9
Ireland	4
Iran	1
Israel	4
Italy	13
Japan	22
Korea	8
Lebanon	2
Luxembourg	1
Mexico	11
Morocco	1
Netherlands	6
New Zealand	1
Nigeria	1
Norway	6
Pakistan	15
Panama	1
Peru	4
Philippines	16
Portugal	5
Spain	10
Sweden	3
Switzerland	3
Thailand	14
Turkey	7
Union of South Africa	2
United Kingdom	6
Venezuela	5
Vietnam	2
Yugoslavia	1
TOTAL	361

TABLE II: PARTICIPANTS IN THE INTERNATIONAL SCHOOL OF NUCLEAR SCIENCE AND ENGINEERING
(Includes all areas)
COURSES

COUNTRY	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	TOTAL
	Mar. 1955	Nov. 1955	Apr. 1956	Sept. 1956	Feb. 1957	Sept. 1957	Feb. 1958	Sept. 1958	Feb. 1959	
Afghanistan						1	1			2
Argentina	2		2							4
Australia	2									2
Austria				2	1	1	2	1		7
Belgium	4	1			2		2	2	1	12
Brazil	1		1	5		3	2		2	14
Burma		1	1		1	2	1	1		7
Ceylon			1							1
Chile		1	1	1	1		1			5
China		1	1	1	2	2	4	2	1	14
Cuba					2					2
Denmark			2		2					4
Ecuador				1					1	2
Egypt	2	3	2	1						8
Finland			1		1		1		1	4
France	2	2	2	3	3	3				15
Germany		4	4	4	4	4	3	3	1	27
Greece	2		2	2	1		4	3	2	16
Guatemala	1									1
India		1		2	1	2	3	3	3	15
Indonesia	1					2		2		5
Iran				1	1				1	3
Iraq		1			2		2			5
Israel	1	1		1		1	1	2	2	9
Italy		4	5	4	4	6	5	4	3	35
Japan	2	4	3	2	3	4	3	4	5	30
Korea			2	3	2	3	4	6	2	22
Mexico	1	1				1				3
Netherlands				1		3	3		2	9
Norway		1	1							2
Pakistan	1	1	2		5	4	3	5		21
Peru						1	2			3
Philippines	1	2	2		2	2	1			10
Portugal	1				2					3
Southern Rhodesia					1					1
Spain	2	3	4	5	3	5	2	5	5	34
Sweden	1	1		1	5				2	8
Switzerland	1		3	2	1	2	1	1		11
Thailand	2	2		2		2	3	3	1	15
Turkey		4	1	2	2	1			1	11
Uruguay				2						2
Venezuela			2				1	3		6
Viet-Nam									1	1
Yugoslavia			2	1					1	4
Union of South Africa									1	1
TOTAL	50	39	47	48	53	55	55	50	39	416
United States	9	21	20	14	14	11	5	7	5	106
GRAND TOTAL	39	60	67	62	67	66	60	57	44	522

TABLE III: FOREIGN PARTICIPATION IN NUCLEAR REACTOR OPERATION SUPERVISION COURSE

(Oak Ridge National Laboratory)

Country	Number of Participants	1st Course	2nd Course
Belgium	2	0	2
Brazil	1	1	0
China	2	1	1
Denmark	1	0	1
Germany	2	1	1
Israel	1	0	1
Italy	2	1	1
Japan	2	1	1
Pakistan	1	0	1
Philippines	1	1	0
Spain	1	1	0
Switzerland	1	1	0
Thailand	1	0	1
United Kingdom	1	1	0
Vietnam	1	1	0
Sub Total	20	10	10
United States	1	0	1
TOTAL	21	10	11

TABLE IV: FOREIGN PARTICIPATION IN NUCLEAR REACTOR HAZARD EVALUATION
(Oak Ridge National Laboratory)

Country	Number of Participants	1st Course	2nd Course
Belgium	1	1	0
Brazil	1	0	1
China	2	1	1
Denmark	1	1	0
France	1	0	1
Germany	2	2	0
Israel	1	1	0
Italy	5	2	3
Japan	4	2	2
Pakistan	1	1	0
Philippines	1	1	0
Spain	2	1	1
Switzerland	1	1	0
Thailand	1	0	1
United Kingdom	2	2	0
Venezuela	1	0	1
Vietnam	1	0	1
Sub Total	28	16	12
United States	2	0	2
TOTAL	30	16	14

TABLE V: PUERTO RICO NUCLEAR CENTER ENROLLMENT
(By FY and Country of Origin)

Country	FY 1958	FY 1959	FY 1960*
Argentina	1	0	6
Bolivia	1	0	1
Brazil	0	0	1
Chile	1	1	2
Colombia	1	7	3
Costa Rica	0	2	0
Cuba	0	1	1
Dominican Republic	0	0	1
Ecuador	3	0	1
Haiti	0	0	1
India	1	0	0
Jamaica	0	0	1
Mexico	0	5	2
Nicaragua	0	0	2
Peru	0	1	4
Philippine Islands	1	0	0
Spain	0	1	2
Uraguay	0	1	1
United Kingdom	0	0	1
Venezuela	0	1	3
Sub Total	9	20	33
United States	6	8	1
Puerto Rico	36	62	31
Sub Total	42	70	32
GRAND TOTAL	51	90	65

*Includes summer and first semester attendance.

TABLE VI: FOREIGN PARTICIPATION IN THE RADIOCHEMICAL AND COUNTING PROCEDURES COURSE
(Health and Safety Laboratory, New York)

Country	Number of Participants
Belgium	2
Brazil	1
Canada	1
Denmark	1
Germany	5
India	2
Mexico	1
Netherlands	2
Norway	1
Pakistan	1
South Africa	2
Thailand	3
Turkey	1
TOTAL	23

TABLE VII: FOREIGN PARTICIPATION IN NS SAVANNAH COURSES

A. NS SAVANNAH Construction Observation Course, Camden, New Jersey

Country	Number Participants	FY 1959	FY 1960			
		1st Course 4/15	2nd Course 7/6	3rd Course 8/31	4th Course 10/26	5th Course 12/21
Denmark	1					1
France	2		1	1		
Germany	2		1		1	
Italy	2		1	1		
Japan	3	2				1
Norway	4	2			1	1
Sweden	3		1		1	1
United Kingdom	3			2	1	
Total	20	4	4	4	4	4

NOTE:
6th Course, scheduled to begin 2/15/60, will include 5 foreign nationals.

B. NS SAVANNAH Reactor Engineering Officers' Training Course

In the course held at the Babcock and Wilcox plant, Lynchburg, Virginia, for training of engineering officers of the first nuclear powered merchant ship, seven (7) foreign nationals representing the following countries participated:

Denmark.....	1
Japan.....	4
Netherlands.....	1
United Kingdom.....	1
TOTAL.....	7

TABLE VIII: SHIPPINGPORT NUCLEAR POWER STATION TRAINING COURSE
(Shippingport, Pennsylvania)

Country	Number Participants	FY 1959 1st Course 2/9/59	FY 1960 2nd Course 7/13/59
Belgium	2		2
China	1	1	
India	1	1	
Italy	1	1	
Japan	3	1	2
TOTAL	8	4	4

NOTE:
A new course is being developed and is scheduled to begin April 4, 1960.

TABLE IX: ALIEN EMPLOYEES[1/] AND GUESTS - AEC INSTALLATIONS, INDIVIDUAL, ON-THE-JOB TRAINING ASSIGNMENTS

COUNTRY	FY 1954 and Prior	FY 1955	FY 1956	FY 1957	FY 1958	FY 1959	FY 1960 Thru 10-31-59
Afghanistan	0	0	0	0	1	1	0
Argentina	0	0	1	9	10	15	17
Australia	0	0	0	1	4	7	5
Austria	0	0	2	3	6	8	4
Belgium	0	0	9	25	22	20	13
Bolivia	0	0	0	0	0	0	0
Brazil	0	0	0	4	6	9	7
Burma	0	0	0	0	2	2	2
Canada	0	1	10	28	42	39	36
Ceylon	0	0	0	0	1	1	0
Chile	0	0	0	3	5	3	0
China	0	1	7	22	31	31	40
Colombia	0	0	0	1	1	1	2
Cuba	0	0	0	2	3	4	3
Denmark	0	0	0	0	2	5	6
Ecuador	0	0	0	0	0	1	0
Finland	0	0	0	2	3	5	4
France	0	0	8	18	23	17	14
Germany	1	2	11	38	54	36	43
Greece	0	0	3	5	9	8	8
Hungary	0	0	0	1	1	1	0
India	0	0	4	10	19	26	34
Indonesia	0	0	0	0	1	0	3
Iran	0	0	0	2	1	1	3
Iraq	0	0	0	0	0	1	0
Iceland	0	0	0	0	2	4	5
Israel	0	0	2	9	7	9	13
Italy	0	0	4	18	22	26	30
Japan	0	1	7	31	46	50	48
Jordan	0	0	0	0	0	1	0
Korea	0	0	2	1	6	11	3
Latvia	0	0	0	0	1	1	1
Lebanon	0	0	0	0	0	1	1
Liechtenstein	0	0	0	0	1	1	1
Luxembourg	0	0	0	0	1	1	1
Mexico	0	0	0	1	3	2	1
Netherlands	0	0	3	10	12	15	12
Norway	0	0	1	4	5	7	6
Pakistan	0	0	0	5	7	10	6
Peru	0	0	0	0	0	0	2
Philippines	0	0	0	3	4	4	6
Portugal	0	0	0	1	2	4	2
Spain	0	0	5	4	9	11	9
Sweden	0	0	3	9	9	11	11
Switzerland	0	0	1	6	11	13	13
Saudi Arabia	0	0	0	0	1	0	0
Thailand	0	0	1	3	6	2	2
Turkey	0	0	0	9	19	14	19
Union of So. Africa	0	0	1	2	2	2	2
United Arab Republic	0	0	2	6	5	4	6
United Kingdom	0	0	11	43	62	65	80
Uruguay	0	0	0	2	2	0	0
Viet-Nam	0	0	0	0	0	2	2
Venezuela	0	0	0	0	0	1	2
Yugoslavia	0	0	0	2	3	4	6
TOTAL	1	5	98	343	495	518	534

1/ As defined in AEC Manual Chapter 4206.

Appendix A

Some of the Foreign Scientists Who Have Participated In the U.S. Training Programs and Their Present Work

1. ORINS Courses:

Beninson, Dan J. (Argentina), in charge of radiochemistry laboratory for Argentine AEC.
Lebrun, Andre J. G. (Belgian Congo), labelling tsetse flies for migration studies.
Tavernier, Guy (Belgium), active in Belgium and OEEC nuclear power program.
Roser, Francis X. (Brazil), Brazilian representative to United Nations fallout study group.
Fee, Donald A. (Canada), active in radiotherapy.
Fraser, Donald A. (Canada), using tracer techniques with radioisotopes to study insects in forests.
Larrain, Camilo (Chile), conducting endemic goiter studies.
Cortazar, Jaime (Colombia), in charge of radioisotope program in Colombia.
Marulanda, Tulio A. (Colombia), Executive Director of Colombian Institute of Nuclear Affairs.
Alonso, Marcelo (Cuba), Technical Advisor of The Nuclear Energy Commission of Cuba.
Gonzalez, Rafael B. (Dominican Republic), in charge of medical radioisotope program for Dominican Republic.
Mahmoud, Kamal (Egypt), in charge of nuclear training center.
Daikos, George K. (Greece), in charge of medical radioisotopes program for Greece, member of Greek AEC.
Kouyoumzelis, Theodore G. (Greece), Vice-chairman of Greek AEC.
Liem, King Han Pete (Indonesia), establishing medical radioisotopes laboratory.
Toebe, Annie (Indonesia), establishing medical radioisotopes laboratory.
Anbar, Michael (Israel), in charge of radioisotope training center, presented a paper at Geneva Conference.
Cavalcanti, Romano C. (Italy), teaches a radioisotope course.
Hirata, Yutaka (Japan), works at Atomic Energy Research Institute.
Moreno-Moreno, Augusto (Mexico), in charge of nuclear training program for national government.
Rafter, Thomas A. (New Zealand), in charge of the Division of Nuclear Sciences of the Department of Scientific and Industrial Research.
Cambel, Perihan (Turkey), active in cancer research.
Roche, Marcel (Venezuela), in charge of Venezuelan Institute of Scientific Research which is responsible for a research reactor.
Carminatti, Hector (Argentina), Department of Radiochemistry, Argentine Atomic Energy Commission.
Mas, Felipe R. (Argentina), Department of Radiobiology, Argentine Atomic Energy Commission.
Olascoaga, Mario L. (Argentina), Goiter Institute, University of Cuyo Medical School.

Appendix "A" continued

Gianella, Rafael (Brazil), Faculty of Medicine of the University of Sao Paulo.
Otero-Ruiz, Efraim (Colombia), in charge of Radioisotopes and Endocrinology Department, National Cancer Institute.
Laosa, Ovidio (Cuba), Ministry of Health and Curie Cancer Institute.
Alba-Andrade, Fernando (Mexico), in charge of Nuclear Physics Laboratory, University of Mexico.
Bedoya P., Julio A. (Peru), Department of Radiotherapy, Hospital Obero.
Correa, Javier (Peru), Institute of Skin Diseases and Institute of Andean Biology.
Souto Candeira, Jose (Venezuela), Department of Engineering, University City.
Roca Vila, Reclus (Venezuela), Department of Engineering, University City.
Luyen, Phan Cao (Viet-Nam), Radiochemistry Department, Viet-Nam Atomic Energy Office.
Olarte, Jose A. (Argentina), employed by Argentine Atomic Energy Commission.
Goens, Julian R. J. (Belgium), in charge of Mol Laboratory.
Abou Sinna, Ibrahim A. (Egypt), Department of Radiology, Ibrahim Pasha University.
Dardano, Ruben Montufar (El Salvador), Department of Radium, Hospital Rosales.
Dimitroulas, Christ P. (Greece), employed by Greek Atomic Energy Commission.
Samara, Vryssiis (Greece), Radioisotope Department, Maieytirion Alex Hospital.
Bora, K. C. (India), Department of Atomic Energy, Indian Cancer Research Centre.

Appendix "A"

2. International School of Nuclear Science & Engineering

Present activities of a sample of the 522 graduates of the International School of Nuclear Science and Engineering are presented. Some of the outstandingly successful graduates have described their present activities; others are shown more briefly to indicate the range of responsibilities fulfilled.

Dr. Norman Hilberry, Director of the Argonne National Laboratory, stated recently that all but a very few graduates were actively engaged in the nuclear science programs of their countries.

ARGENTINA

Buchler, Carlos, employed with International Atomic Energy Agency.

AUSTRALIA

A. R. W. Wilson
Australian Atomic Energy Commission
45, Beach Street
Coogee, N. S. W., Australia

Head, Technical Policy Section

I am responsible for the headquarters group concerned with the formulation of technical policy for decision by the Commission and its subsequent implementation. Technical policy matters include international atomic energy relations, commercial policy, raw materials matters, external research and parliamentary liaison.

Until recently, I have occupied the position of Head of the Health Physics Section at the Commission's Research Establishment at Lucas Heights. I have accepted my new duties with the understanding that I would, upon request, be able to return to my technical position in July 1960.

Some of the more challenging problems with which my section is now faced are concerned with the current depression in the demand for uranium, the Commission relationship to other Commonwealth and State bodies in the radiation protection field, isotopes supply and distribution, and information exchanges with overseas countries.

The Australian Atomic Energy Commission is the Commonwealth Authority responsible for the oversight of the exploration and the mining, treatment and sale or disposal of atomic energy raw materials. Its further responsibilities include atomic energy research and development, isotope production, the encouragement of education and the dissemination of

information in the atomic energy field and under special circumstances the construction and operation of atomic energy power plants.

BELGIUM

Jean A. Storrer
Belgonucleaire
Societe Belge pour l'Industrie Nucleaire
35 rue des Colonies
Brussels, Belgium

Chief Engineer

Societe Belge pour l'Industrie Nucleaire (Belgonucleaire) is a company founded by and composed of 47 manufacturing companies of Belgium which joined their efforts in the nuclear field. Specific activities include design and sale of reactors and nuclear components, applications and sale of isotopes, and the study of plutonium as fuel.

Responsibilities since early 1958 until criticality at the end of 1960 have been to take charge for my company, as nuclear architect-engineer, the BR-3 nuclear power plant for the C.E.N. at Mol. After criticality at the end of 1960, I shall be the nuclear engineer for the BR-3 nuclear power plant, responsible for the nuclear department.

Trousson, Marcel, employed by EURATOM.

BRAZIL

Bernardino C. Pontes
Brazilian AEC
350 Marechal Camara/7° Andar
Rio de Janeiro, Brazil

Assistant to the Director for Education and Training

Also professor of reactor design, National School of Engineering. I am in charge of the courses and fellowship programs for the Brazilian AEC. I am also advisor of the Brazilian Delegate in the Inter-American Nuclear Energy Commission (OAS). After having been engaged with the teaching in reactor design, I plan to work in the Reactor Division in the Commission.

BURMA

U Hla Nyunt
Union of Burma Atomic Energy Center
No. 1 Kanbe Road
Yankin P. O.
Rangoon, Burma

U Hla Nyunt (Continued)

Director, Atomic Energy Center

I am responsible for the over-all administration of UBAEC, training personnel, development of the site. Planning Burma's atomic program and fulfilling international obligations through the Foreign Office are additional duties.

The National Atomic Energy Organization is responsible for all atomic matters on behalf of government of Burma. Current objectives are prospecting for atomic raw materials, setting up of a nuclear laboratory using radioisotopes, radioactive fallout monitoring, health physics, nucleonic instrumentation, reactor studies, national energy problems and an atomic library. Future objectives are a research reactor program and detailed power reactor studies.

CHILE

Efrain M. Friedmann
Jefe Oficina Ingenieria Nuclear
Empresa Nacional de Electricidad (S.A.)
Casilla 1392
Santiago, Chile

Chief, Office of Nuclear Engineering

ENDESA is a utility created by the government for the purpose of electrifying the entire country. It is the main utility of Chile. It has both thermal and hydroelectric plants. It is currently studying the possibility of using nuclear power in the northern part of the country should it prove suitable from an economic point of view.

I am the individual directly in charge of carrying out the technical, economical and general studies concerning the installation of nuclear power plants by ENDESA. I also participate in the committees studying the law creating the Chilean Atomic Energy Commission. Once the atomic energy law has been passed by Congress, I will probably be attached to the Chilean Atomic Energy Commission as a member of the Board or as a Manager.

CHINA

Cheng, Chen-hwa (Victor), project manager for the Tsing-hua swimming pool reactor at the Institute of Nuclear Science.

Chien, Ji-Peng, in charge of nuclear physics division of Institute of Nuclear Science, Tsing-Hua University.

Chu, Keh-chang, working on research reactor project at Institute of Nuclear Science, Tsing-Hua University.

CHINA (Continued)

Ko, Pao-Shu, employed by Taiwan Power Co. on loan to Institute of Nuclear Science at Tsing-Hua University to work on research reactor project.

Lee, Min-Li, working on research reactor project at Institute of Nuclear Science, Tsing-Hua University.

Lin, Chia Shi, working on research reactor project at Institute of Nuclear Science, Tsing-Hua University.

Tseng, Der-ling, working on research reactor project at Institute of Nuclear Science, Tsing-Hua University.

Yang, Teh Li, working on research reactor project at Institute of Nuclear Science, Tsing-Hua University.

DENMARK

Kongsoe, Hans E., supervisor at the DR-2 reactor.

Mehlsen, Soren, Head of the DR-3 10 mw research reactor.

Olgaard, Povl, Head of the Reactor Group, Reactor Engineering Department, Danish Atomic Energy Commission.

FRANCE

Pernet, Paul-Marie, employed in the Research and Development Division of EURATOM.

GERMANY

Albert Ziegler
Siemens-Schuckerswereke AG
Abt Reaktor-Entwicklung
Schillerstrasse 62
Erlangen, Germany

Chief, Reactor Physics Department

Responsibility for design and construction work on a 50 MW_o D_2O power reactor project. Construction probably will be started in 1960. Our department for Reactor Development is working on some other projects, such as: 100 MW_e D_2O moderated power reactor under design contract with "Atomkraft Bayern," Argonaut Reactor for "Kernreaktor Karlsruhe," Control system for the D_2O Research Reactor Karlsruhe, Control system for a 100 MW_e graphite moderated gas cooled power reactor of the German Babcock and Wilcox.

Sahl, Wilhelm, member of the economic and Industrial Affairs Department of EURATOM at Brussels.

GREECE

Chrysochoides, Nicholas G., acting research reactor supervisor for Greek AEC.

Danielopoulos, Stylianos D., with Greek AEC.

Lascaris, Constantine Athanasios, in charge of control instrumentation for Greek AEC reactor.

Papdimitropoulos, Tacis Basilios, working on Greek AEC reactor project.

INDIA

N. Lakshmanachar
Reactor Engineering Division
Atomic Energy Establishment
Apollo Pier Road
Bombay 1, India

Design Engineer

Ours is a government organization. This establishment is the only active institution in India which is responsible for the developmental work in atomic energy. This includes design, construction and utilization of research and power reactors and allied facilities.

I am at present in charge of the erection and start-up of our third research reactor, ZERLINA. This is a zero energy reactor used for lattice studies. Initially it will be used with natural uranium, heavy water and graphite reflector. I am also designing irradiation facilities for using cobalt 60 and other gamma sources. Our organization intends to use atomic energy for producing electrical power. My present duties are not connected with this work but when we actually launch a power reactor project I expect to be given responsibility in it.

Prabhakar, Bangalore S., working on the control and instrumentation of a low power heavy water experimental reactor.

IRAN

Azad, Ali Asghar, in charge of Iranian research reactor Project.

Rouhani, Sayd Zia, faculty of University of Tehran and works on Iranian reactor project.

ISRAEL

Yewin, Yehudah, with Israeli AEC.

JAPAN

JAPAN

Mikio Hada
Nippon Atomic Industry Group
Co. Ltd. 4, Yurakaé Cho
2-chome, Chiyoda Ku
Tokyo, Japan

Chief Nuclear Engineer

Engineer in charge of developing research reactors and critical assemblies including experimental facilities. Nippon Atomic Industry Group Co. Ltd., is formed by more than 40 leading companies of this country to share results of developmental and research activities. Present activity of the company covers manufacture of facilities of nuclear field and research.

My present job is planning nuclear or engineering facilities for universities, institutes, etc. Future object of my company will cover very wide range of nuclear industry under cooperation of our 42 backmakers. Our job will be construction and engineering of all kinds of reactors, critical assemblies, their accessories, experimental facilities, accelerator, medical application, material development, etc.

Ishihara, Takehiko, deputy chief of a chemical engineering group at JAERI.

Kiyose, Ryohei, Nuclear Engineering Laboratory, Faculty of Engineering, University of Tokyo.

Togo, Yasumasa, assigned to Japan's power demonstration reactor, a BWR type of 12.5 mwe output.

KOREA

Byun, Chong Hwa, associated with Korean research reactor project.

Jae, Won Mook, associated with Korean research reactor project.

Kim, Suk Yun, associated with Korean research reactor project.

Rhee, Chin Taik, associated with Korean research reactor project.

Song, Yo Taik, works in Reactor Division, Atomic Energy Research Institute.

Yoon, Se Wan, employee of Office of Atomic Energy.

NETHERLANDS

Van Erp, Jan, associated with EURATOM in the field of nuclear research and development.

NORWAY

V. Olavi Vapaavouri
Institut for Atomenergi
Box 173
Halden, Norway

Reactor Engineer, Halden Reactor Project

The work involves the conception and design of experimental and routine operating procedures with the specification and safe methods of operation; the development of equipment and techniques to be used during future modes of operation; and taking personal charge of the reactor plant and the shift crew during experimental operation.

The Halden reactor is owned by the Institut for Atomenergi which is also responsible for its operation. The participating European countries have sponsored a joint program of research and experimentation over a three-year period which was started in July 1958. The joint program is intended to provide technical information relating to boiling water reactors in the development of economic power producing units.

PAKISTAN

Khan, Munir, Reactors Branch of the International Atomic Energy Agency.

Mehmud Salim, employee of Pakistan AEC in nuclear training and research laboratory.

Shafique, Muhammad, employee of Pakistan AEC, engaged on research reactor project.

Yusuf, Mohammed, employee of Pakistan AEC, working on reactor project.

PHILIPPINES

Florencio A. Medina
Philippine Atomic Energy Commission
727 Herran Street
Manila, Philippines.

Commissioner

Stimulate and guide scientific, engineering and technological efforts toward filling the basic and immediate needs of the people;
Survey the scientific, engineering and technological resources of the country and formulate a comprehensive program for the development and maximum utilization of such rescources in the solution of the country's problems;
Strengthen the educational system of the country so that the same will provide a steady source of competent scientific and technological

Florencio A. Medina (Continued)

manpower;
Furnish incentives to private and individual initiative in scientific work, as a fundamental basis for the advancement of science.

PORTUGAL

Baptista, Antonio Manuel, associated with Portugal research reactor.

Claro da Fonseca, Antonio Jose, associated with Portugal research reactor.

SPAIN

Jose R. Lopez-Rua
Junta de Energia Nuclear (Spanish AEC)
Serrano 121
Madrid, Spain

Assistant to the Vice President

Advise on technical policy matters involving negotiations with foreign agencies, institutions, or industries. Will be project manager of next Spanish reactor project.

Goicolea, Francisco J., engaged in the Spanish AEC project of a 30 MWE reactor for fuel testing and power.

SWEDEN

Mileikowski, Nuclear Power Department of Allamnna Svenska Elektriska Aktiebolaget.

SWITZERLAND

Andrew A. F. Fritzsche
Reaktor AG
Wurenlingen AG, Switzerland

Technical Director, "Reaktor AG"

"Reaktor AG" Wurenlingen is to be changed on May 1, 1960 to "Federal Institute of Reactor Research." Objectives: Construction of D2O-Unat-Research Reactor DIORIT, Operation of reactors SAPHIR (Swimming Pool) and DIORIT and of Laboratories (Hot Lab, tech. lab in construction) for technical research and reactor development in close contact with industry.

Responsible for engineering; at present design and construction of DIORIT, planning of technical laboratory and other extensions of facilities, in future increasingly for research and development in frame of Swiss reactor program. As such responsible for close contact with corresponding

Andres A. F. Fritzsche (Continued)

industries. Technical advisor to Sulzer Bros., Ltd., Swiss representative in Technical Committee of DRAGON project.

Presently the financing of prototype power reactor projects in Switzerland is still in discussion. Government is prepared to participate with maximum of 50%. Of three projects studies one or two will be built. As of May 1 our own company will be fully government financed as a centralized research institute. ISNSE graduates play an important role in Swiss activities.

Hintermann, Karl, working on the OEEC project, "Dragon", a high temperature gas cooled reactor.

THAILAND

Boonsaith, Tongrakon, working on the Thailand research reactor project.

Fuangtura, Pairag, working on Thailand research reactor project.

Satapitananda, Prasom, associated with Thailand research reactor project on health physics and waste disposal.

TURKEY

Akcasu, A. Ziya, associated with Turkish research reactor project - electronic control instrumentation.

Akpinar, Sait, associated with Turkish research reactor project.

Cilesiz, Ayhan, associated with Turkish research reactor project.

Domanic, Fahri, teaches reactor engineering in University of Ankara, active in Turkish reactor project.

Imre, Kaya, associated with Turkish research reactor project.

Senvar, Cemil, teaches radiochemistry at University of Ankara, active on Turkish reactor project.

VENEZUELA

Rada A., Gustavo, employed by Venezuelan Institute of Scientific Research doing pre-criticality preparations for their reactor.

Appendix "A" continued

3. Radiochemical and Counting Procedures Course (Health & Safety Laboratory, N.Y.):

Trooskens, Willy Louis (Belgium), Radiochemist, Centre d'Etudes de l'Energie Nucleaire.
Vander Stricht (Belgium), Physicist, Centre d'Etudes de l'Energie Nucleaire.
Mar, Peter (Canada), Radiochemist, Radiochemical Laboratory, Dept. of Nat'l Health & Welfare, Ottawa, Canada
Aarkong, Aaker (Denmark), Health Physicist, Danish Atomic Energy Comm.
Donth, Hans Dr. (Germany), Physicist, Asst. Advisor, Federal Ministry for Atomic Energy & Water Resources, Bad Godesberg, Germany.
Hinzpeter, Max, Dr. (Germany), Chief, Instrumental & Upper Air Surveillance of Radioactivity, Deutscher Wetler-dienst, Zentralamt, Offenbach, Deutschland.
Vohre, K. G. Dr. (India), Air Monitoring Tower, Atomic Energy Establishment, Trombay, Bombay, India.
Vazl, G. H. (India), Electronics Div., Atomic Energy Establishment, Trombay, Bombay, India.
Richards, George (Mexico), Nat'l University of Mexico
Institute of Physics, University City, Mexico.
Post, Jacob (Netherlands), Scientific Assistant, Institute of Physical Research, The Netherlands.
Halvorsen, Karen Miss (Norway), Radio Chemist, Institutt for Atomenergi, Lillestrom, Norway.
Verwey, C. J. (South Africa), Physicist, Nuclear Physics Division, National Physics Lab.
Rochanapuraranda, P. (Thailand), Radio Chemist, Radiochemical Procedures, Thai Atomic Energy Commission for Peace.
Manunapichu, K. Dr. (Thailand), Chemist, Thai Atomic Energy Est., Science Department, Thayaphay, Bangkok.
Emstan, V. Dr. (Turkey), Chemist, Asst. Professor, Physical Chemistry, Faculty of Science, Ankara University, Ankara, and associated with Turkish reactor project.

APPENDIX "B" -- PORTION OF THE DOMESTIC TRAINING PROGRAM PERTINENT TO THE INTERNATIONAL PROGRAM

The USAEC contributes substantially to the broad domestic program of education and training in the nuclear sciences. Some of the many facets of that program provide a ready and appropriate framework for also training foreign nationals. Those portions of the domestic nuclear training program which make a significant contribution to the international training program and which have not been covered in the main body of the report are discussed in this appendix.

A. AEC Specialized Fellowship Programs:

The AEC provides specialized fellowships to U. S. nationals designed to meet the specialized needs of the Atomic Energy program. Although foreign nationals are not accepted as fellows, they generally may participate in the same training program, even to the extent, in many cases, of taking the specialized portions of the schedule setup specifically for the fellows, such as on-the-job training at one of the national laboratories. The ability of the participating universities to provide students with well-equipped laboratories is possible to a large extent through the fellowship programs and the domestic equipment grant program which is taken up later in the report.

The following specialized fellowship programs are presently available:

1. Fellowship in Nuclear Science and Engineering--In October, 1956 the Commission authorized 150 fellowships per year for study in a nuclear energy technology curriculum. These fellowships are administered by the Oak Ridge Institute of Nuclear Studies, with University participation being obtained through the Oak Ridge Operations Office. Of the 48 participating universities (as of December, 1959), 38 have, or are acquiring, subcritical facilities, 29 have, or are acquiring, research and/or training reactors, and all 48 have a substantial amount of nuclear equipment and materials.

2. Fellowships in Health Physics (formally called Radiological Physics)--Health physics is the science and profession of protecting people and their environment against the damaging effects of radiation. In 1948, the Division of Biology and Medicine began a program to train health physicists primarily for AEC projects. During the first two years, the training was given in the Oak Ridge National Laboratory and in the Atomic Energy Project at the University of Rochester. In 1950, the plan was changed, to give one year of university graduate-level training in the associated sciences of radiation physics and biophysics, interaction of radiation with living systems,

Appendix "B" continued

dosimetry and instrumentation, etc., to be followed by 10 weeks of on-the-job field training in one of the national laboratories. In some cases, the trainees receive the M.S. degree. At the present time, participating universities are Vanderbilt, Rochester, Harvard School of Public Health, Michigan School of Public Health, Kansas, Washington (Seattle), California (Berkeley), and Puerto Rico. Participating laboratories are Oak Ridge, Brookhaven, Argonne, National Reactor Testing Station, and Hanford. The program is administered by ORINS. Aproximately seventy-five fellowships are offered each year.

Summer Institutes for Faculty Training. Because the high school science teachers and the biology teachers in liberal arts colleges are in a position to interest young people in careers in science, the Division of Biology and Medicine of the USAEC provides special training in radiobiology institutes for these teachers. The Commission shares with the National Science Foundation the financial support of 8-week summer institutes, 20 student-teachers at each. The AEC implements its support of this program through the provision of teaching equipment to each institute participant, which he is allowed to take back to his own school at the end of the institute course. Each kit consists of a scaler-ratemeter with Geiger tube, accessories and maintenance manual, reference sources consisting of radium and cobalt-60 in properly sealed containers, radiation absorbers, and manuals to assist instruction at a suitable level.

This program has proved to be one of the most enthusiastically received activities of the Commission, popular with the teacher participants, the host universities, the sponsoring agencies, and markedly so with the public. Other countries and international organizations have expressed an interest in using this technique for their own purposes.

Summer Institute Program in Reactor Technology. The Commission on October 17, 1955, authorized the establishment of a summer institute program for teachers in nuclear engineering, jointly sponsored by the AEC, the NSF, and the American Society for Engineering Education (ASEE). On April 9, 1957, the Commission authorized "the payment of grants to universities and colleges for stipends and travel expenses of faculty attending Nuclear Energy Technology Summer Institutes for University Faculty."

The summer institutes are designed to provide opportunities for university faculty members to learn the latest developments in the reactor field, and to gain experience in dealing with the problems of design, fabrication and operation of nuclear reactors so that they can incorporate this knowledge into the nuclear courses they will be teaching at their sponsoring universities. To date these institutes have been conducted primarily for engineering schools and non-profit technical institutes(1) faculty and secondarily for faculty from chemistry,

(1) Technical institutes are two to three year colleges for training engineering technicians.

Appendix "B" continued

mathematics and physics departments supporting engineering schools.

The technical content of the institutes is constantly altered as required to recognize the continued expansion of university nuclear programs. The chart on the next page describes the summer institutes held to date.

These summer domestic programs have broadened the curricula of American colleges and universities to the extent that the Atomic Energy Commission is now able to direct a great many individual requests for training in nuclear science and engineering to sources other than Commission facilities. This permits the elaborate equipment at our national laboratories to be utilized for only the most advanced training.

Plans are being developed to admit a limited number of foreign nationals to both the summer institutes for faculty training and the AEC-ASEE summer institute activity. This will obviously strengthen the overall training program and gradually enable the Atomic Energy Commission to concentrate still more on the advanced development of nuclear science and engineering training which in turn adds to international prestige.

Appendix "B" continued

Summer Institute Held During CY 1956-1959

Title	Year	Location	Schools Sending Trainees	States Represented	Faculty Trained
Basic Institute in Nuclear Technology for University Faculty	1956	Argonne National Laboratory Brookhaven National Laboratory			
Basic Institute in Nuclear Technology for University Faculty	1957	Brookhaven National Laboratory			
Basic Institute in Nuclear Technology for University Faculty	1958	Univ. of Calif., Berkeley with RAD, Lab.			
	1958	Purdue University with ANL			
	1958-1959	Cornell University with BNL			
	1958-1959	N.C. State College with ORNL	113(1)	45*(1)	282(1)
Basic Institute for Technology Institute Faculty	1958-1959	Penn State University with ANL	28	18	51
Nuclear Metallurgy	1957-1958	Ames Metallurgical Laboratory	26	17	31
Chemical Processing	1957-58-59	Hanford	24	17**	25
Use of Training Reactors	1957	Argonne National Laboratory	8	8	8
Reactor Physics	1957	Oak Ridge National Laboratory	13	8**	14
Reactor Theory & Practice	1958	University of Michigan	20	15**	20
Instrumentation & Control	1958	Argonne National Laboratory	12	9**	15
Specialized Nuclear Studies	1959	Argonne National Laboratory	15	11*	18
Special Topics in Reactor Design	1959	University of Michigan	17	10**	19
		Grand Total	147	46**	483***

NOTES:
* Plus Puerto Rico
** Plus Puerto Rico and the District of Columbia
*** Actually represents 423 individuals
(1) Represents total attendance in the 9 basic institutes.

Appendix "B" continued

Financial Assistance for Nuclear Equipment and Loan of Nuclear Materials. On August 2, 1956, the Commission approved the granting of financial assistance for nuclear equipment and the loan of nuclear materials to universities and colleges to encourage the establishment and expansion of nuclear education in the physical sciences and engineering. It was intended that courses similar to the graduate level courses offered at the Oak Ridge School of Reactor Technology and the International School of Nuclear Science and Engineering be available at educational institutions. Such courses would enable larger numbers of graduate students to obtain instruction in the nuclear field.

Thus far, 106 domestic schools have been loaned, without charge, neutron sources, natural uranium reject slugs, enriched uranium and other nuclear materials for use in their nuclear instructional laboratories. Under this nuclear materials loan activity, 30 subcritical assemblies have been built or are planned by colleges and universities using their own, rather than AEC grant funds.

Schools receiving AEC grants contribute substantial amounts of their own funds to establish their nuclear educational program. On the average, for every two AEC dollars for nuclear equipment, universities and colleges contribute one dollar for laboratory floor space and one dollar per year for professors' salaries.

Equipment Grants for Training in Nuclear Technology as Applied to the Life Sciences. The AEC recognizes a responsibility to help assure a supply of professional people who are highly trained in the nuclear aspects of the life sciences (i.e., biology, medicine, nursing, public health, pharmacy, agriculture), sufficient to meet the growing needs of government, educational institutions and private industry in the United States. There is an additional, and extremely serious, need among teachers and the interested public for a better understanding of the biological effects of radiation. Such persons, we believe, will in the long run be the best stabilizing influence in our efforts to combat undue fear of radiation.

To help meet this responsibility, the Division of Biology and Medicine has been conducting a program for the enhancement of the quality of instruction in nuclear technology as applied to the life sciences, by providing financial assistance to nonprofit educational institutions for the purchase of nuclear equipment and materials. The funds provide teaching aids, demonstration apparatus and student laboratory equipment to be used in teaching radiation biology, radiation protection, and the use and handling of isotopes in research and medicine. Typical items which are allowable for grants are:

Appendix "B" continued

(a) Radiation detection, monitoring and counting instruments for course work.

(b) Equipment for laboratory instruction in the analytical chemistry of radioactive materials for direct application in the life sciences.

(c) Equipment for laboratory instruction in the problems of health physics; for example, waste disposal, radiation hazards and controls, etc.

(d) Radioactive isotopes.

(e) Books, manuals, brochures, films and library aids specific to the proposed instruction.

(f) Laboratory equipment (such as glassware) that is not otherwise available and that is to be used primarily in connection with the proposed instruction.

Through FY 1959, 128 educational institutions have received 193 awards in the total amount of $2,192,805 for educational equipment to be used in courses in the life sciences. In order to reflect the major areas encompassed by the term "life sciences", the disposition of these funds is shown in the categories below.

Area	Number of Awards	Funds Awarded
Agriculture	15	$ 189,522
Medicine	56	739,774
Pharmacy	8	66,753
Public Health	8	153,746
Veterinary medicine	9	97,093
Others*	96	945,917
Total	193	$2,192,805

* Includes Liberal Arts Colleges, and large universities in which funds were distributed to several departments.

This program of assistance to colleges and universities through grants for the acquisition of teaching aids is believed to be one of the most effective and least expensive means of bringing to many students an appreciation of the relative hazards and potential advantages of by-product radiation. Instructors, also, become more familiar with the possibilities of radiation and radioactive isotopes as research tools. As a result, some are encouraged to undertake research projects and become more enthusiastic teachers in the process.

Appendix "B" continued

Equipment Grants for Training in Isotope Technology. The Atomic Energy Commission has recognized for some years a responsibility to assist in the specialized education and training of scientific and technical manpower for the national nuclear energy program. On December 11, 1958, the AEC announced this latest program of assistance to non-profit educational institutions for training and education in radioisotope principles and techniques. From the outset, the purpose of the new program was clearly defined as a phase of the AEC's efforts to foster widespread use of radioisotopes and to increase the number of scientists and engineers qualified to support the growing industrial use of isotopes and radiation. Direct financial assistance is provided in obtaining teaching aids, demonstration apparatus and student laboratory equipment needed to offer adequate laboratory course work in radioisotope principles and techniques. Typical items which are allowable under the program are:

(a) radiation detection, monitoring and counting instruments;
(b) radiation sources and radioactivity standards;
(c) equipment for air contamination demonstrations (smoke generators, air samplers, etc.);
(d) industrial training aids illustrating radioisotope applications; and
(e) auxiliary equipment required for storage, safe handling, and disposal of radioactive material.

In the eight-month period following announcement of the new educational program, 88 requests for assistance were received. In the first and second round of grants, 33 educational institutions in 25 states received a total of $604,416 to establish or improve radioisotope technology instruction. At the present, requests for assistance, totaling over 2 million dollars are still pending.

Currently, the educational program is being broadened to provide specific assistance to the many small colleges presently unequipped to offer training in isotope techniques and handling procedures. Through a tailored series of practical, analytical-type experiments which can be integrated into the existing science curriculum at a cost not to exceed $1,000, the AEC can provide major impetus to the improvement and updating of many small college science curricula. This package unit will be designed to use license-exempt quantities of radioisotopes and simple, commercially available instrumentation.

This major program of assistance to colleges and universities is encouraging the development of specialized courses available to industrial scientists and engineers in the areas of radioisotope and radiation applications.

LETTER OF TRANSMITTAL FROM ATOMIC ENERGY COMMISSION

Since 1955 the Commission has facilitated an increasing number of visits to AEC field installations by foreign nationals.

You may find to be useful the enclosed summary of visits by foreign nationals prepared by the Division of International Affairs. This summary * * * gives the total number of foreign visitors for the years 1955–59 and also a country breakdown. Foreign visitors may spend from one-half a day to several days at an AEC installation; however, the enclosed summary does not reflect the length of time spent by any of the foreign visitors.

UNCLASSIFIED VISITS TO AEC FIELD INSTALLATIONS BY FOREIGN NATIONALS
Arranged by
VISITS COORDINATION STAFF
DIVISION OF INTERNATIONAL AFFAIRS

COUNTRY REPRESENTED	NUMBER OF VISITORS 1955	1956	1957	1958	1959	TOTAL
Afghanistan		1		8	3	12
Algiers			1			1
Argentina	5	4	33	6	14	62
Australia	15	11	16	25	6	73
Austria	6	5	3	4	10	28
Belgian Congo			1			1
Belgium	13	12	74	35	59	193
Bolivia	2	1				3
Brasil	2	13	6	10	12	43
Burma	2	3	4	2	1	12
Cambodia		3			12	15
Canada		1	5	4	2	12
Ceylon		5	2		1	8
Chile		1	8	5	9	23
China	9	24	14	9	9	65
Colombia	4	9	8	2	1	24
Costa Rica	2		1	1	18	22
Cuba		1	3		1	5
Czechoslovakia				1		1
Denmark	5	13	10	9	5	42
Dominican Republic					2	2
Ecuador		3	1	2	1	7
Egypt	3	5				8
El Salvador	1		1			2
Ethiopia					5	5

NAME OF COUNTRY	1955	1956	1957	1958	1959	TOTAL
Federation of Rhodesia & Nyasaland		1	1	2	1	5
Finland	2	6	6	3	5	22
France	25	70	118	73	122	408
Germany	35	74	111	88	113	421
Ghana			1			1
Gold Coast	1					1
Greece	2	4	9	9	6	30
Guatemala	1	1	3		23	28
Haiti	10	1				11
Honduras	1	1				2
Hong Kong	1				1	2
Iceland	1		5	1	3	10
India	11	19	27	15	14	86
Indonesia	10	7	18	5	11	51
Iran	3	1	2	1	2	9
Iraq		1	3	4	1	9
Ireland		4	2	2	2	10
Israel	3	6	2	8	5	24
Italy	8	38	34	24	80	184
Japan	53	199	218	229	178	877
Jordan		4	2		9	15
Kenya			1			1
Korea	3	2	17	8	5	35
Laos			1			1
Lebanon		3	1			4

NAME OF COUNTRY	1955	1956	1957	1958	1959	TOTAL
Libya		1	1			2
Luxembourg			1			1
Malaya	1	1	2	3	3	10
Mexico	1	9	1		48	59
Morocco			1	1		2
Nepal					1	1
Netherlands	5	15	33	16	26	95
New Zealand	1	2	4	4	2	13
Nicaragua		1	1			2
Nigeria			1		1	2
Norway	2	1	8	6	12	29
Pakistan	5	9	10	4	7	35
Palestine					1	1
Paraguay		1	2	1		4
Peru	1		1			2
Philippines	6	2	7	3	5	23
Poland				1		1
Portugal	3	3	4	14	2	26
Sarawak					1	1
Saudi Arabia					1	1
Singapore					2	2
Somalia				1		1
South Africa	6	7	17	2	4	36
Spain	12	21	20	27	14	94
Sudan			1			1
Sweden	11	21	29	41	54	156

NAME OF COUNTRY	1955	1956	1957	1958	1959	TOTAL
Switzerland	3	12	11	10	18	54
Syria	1		1			2
Thailand	11	4	8	9	10	42
Tunisia				1	1	2
Turkey	3	2	4	5	7	21
Uganda		1				1
United Kingdom	22	44	82	79	78	305
Uruguay		4	4	2	1	11
Venezuela		1	2	1	1	5
Viet-Nam	2	3	1	2	1	9
Yugoslavia		4	20	1	8	33
TOTALS	335	726	1050	829	1061	4001

TRANSMITTAL LETTER FROM ATOMIC ENERGY COMMISSION

In your letter dated November 20, 1959, you requested a background paper on the "Isotope, Radiation, and Research Programs of the United States."

With this letter I am enclosing in response to your request [a paper] prepared by the Office of Isotopes Development.

RADIOISOTOPE PROGRAMS

The development in the United States of a broad radioisotope technology and the resultant useful applications have definitely stimulated the utilization of isotopes in other countries. Encouragement of beneficial uses of radioisotopes in other countries has stemmed from the strong isotopes program in the U. S. since as early as 1946.

The first public announcement that reactor produced radioisotopes were available was in June 1946 and the first small shipment of Carbon 14 was made to a hospital on August 2, 1946. This also marked the first private participation in the peaceful uses of atomic energy. The first broad participation of other countries in peaceful uses of atomic energy, hence the very beginning of an International Atoms for Peace Program, was achieved by the first shipment of a radioisotope to another country in September 1947. In February 1956 international distribution of radioisotopes was simplified by removing practically all export controls, permitting U. S. licenses to export routinely radioisotopes of elements with atomic numbers 3 to 83 except to Soviet Bloc countries. Shipments of other radioisotopes plus exports to Soviet Bloc countries may be made after receiving a specific license from the AEC.

An indication of the effect of U. S. isotope programs on other countries may be gained from the following statistics. As of Feb. 1,,1960 , The Special Training Division of Oak Ridge Institute of Nuclear Studies had trained 4,052 scientists in the use of radioisotopes, including 395 foreign participants from 57 countries. There is presently an approved alien quota of 30% (or 108) of the total number of ORINS participants for their radioisotopes courses each year. About 67 countries have been shipped a total of over 14,000 shipments of radioisotopes from the U. S. since 1947.

The Commission's Atoms for Peace Program also provides for exchanges of scientific personnel and information in the field of radioisotope technology.

It is an accepted fact that prices of radioisotopes in other countries are mainly competitive based on price structures in U. S. Outstanding examples are the prices of Cobalt 60 and Carbon 14 which are internationally competitively priced.

For years the U. S. Army has had sole responsibility for a national food-irradiation program embracing three major goals -- meeting not only a military need, but also demonstrating commercial possibilities, and assuring U. S. leadership in a field of important foreign policy consequence. In fact, other countries have held back their food preservation demonstration programs in favor of following the Army Quartermaster Corps national effort.

54953 O—60—vol. 2——16

To a considerable extent worldwide exploitation of industrial, agricultural and medical uses of radioisotopes is based on technology developed in the U. S. Many of the leaders in using radioisotopes in other countries received their advanced training in these techniques in the U. S.

Nuclear power development technology is today beyond the grasp of all but the major industrial countries. However, there is also a shocking lack of development of non-power uses, such as radioisotopes and radiation, which most countries are reasonably capable of exploiting. However, it is necessary to have intimate knowledge of the technological and economic state of development of each country before definite recommendations can be made on isotope and radiation applications for the particular country.

Dr. W. W. Grigorieff, Chairman of ORINS University Relations Division, who recently returned from the post of Chief, Exchange Unit, International Atomic Energy Agency, has stated "Isotopes help promote world understanding." He further believes that IAEA's new laboratory will be especially useful to countries desiring to develop isotope and radiation applications. The laboratory is designed for training of scientists throughout the world in the fields of isotope utilization.

To encourage greater use of radioisotopes in foreign countries an extensive effort is made by our Office of Isotopes Development to help plan and actively participate in appropriate international scientific meetings. For example, the Director of OID has been a member to (1) IAEA Conference on Uses of Large Radiation Sources, Warsaw, 1959, (2) International Congress and Exhibition of Electronics and Atomic Energy, Rome, 1958, (3) UNESCO Conference on Isotopes Research, Paris, 1957, (4) Atoms for Peace Mission to South America, 1956, (5) UN Conference on Peaceful Uses of Atomic Energy, Geneva, 1955, (6) International Cancer Congresses, St. Louis, 1947, Paris, 1950, Sao Paulo, 1954, (7) Inter-American Congress of Radiology, Mexico, 1952, (8) International Congress of Radiology, London, 1950, Copenhagen, 1953.

Plans are being made for a member of OID to attend the Third Inter-American Symposium on Peaceful Applications of Nuclear Energy, July 1960, in Brazil, and Fourth Japan Conference on Radioisotopes, 1961, in Tokyo.

We believe all countries will benefit from the Commission's present Isotopes Development Program which seeks to reduce the time lag between the conception of a new principle (basic research) and its practical application (applied research) and to develop a broad technological base for the exploitation of radioisotopes and radiation in important areas of the national economy including industry, agriculture, medical products and research. Although radioisotopes have been available and the basic principles of use known for the past two decades, their broad application is, with limited exceptions, relatively unexploited. Major developmental work is carried on by several

geographically distributed university centers, private research laboratories, AEC national laboratories and a limited number of industrial organizations and government agencies. Management direction is provided through four sub-programs:

1. Isotope Technology Development
2. Industrial Process Radiation Development
3. Isotope Technology Training
4. Isotope Process Development, Production and Marketing

In fact, one of the prime objectives of the Isotopes Development Program is to make an important contribution to U. S. world leadership in the peaceful uses of atomic energy. The President in a major foreign policy speech before the U. N. General Assembly on August 13, 1958, emphasized the use of isotopes in developing water resources in the Middle East. AEC Commissioner Williams in a speech before the Third Industrial Nuclear Technology Conference on September 23, 1959, stated: "We in our program will be concentrating more and more effort on possible applications of isotope technology to problems such as pollution of air and water which affect the welfare of all people." Several foreign delegates including a Russian team were present at this conference.

We had expected to contract during FY 1960 through the International Atomic Energy Agency with both government and private owned laboratories in foreign countries for isotope development work. Though funds were made available, no adequate proposals have yet been received from IAEA.

LETTER OF TRANSMITTAL FROM ATOMIC ENERGY COMMISSION

In your letter dated November 20, 1959, you requested a background paper on the "Isotope, Radiation, and Research Programs of the United States."

I am happy to enclose for your information a paper on this subject prepared by the Commission's Division of Biology and Medicine.

LIFE SCIENCE PROGRAMS

INTRODUCTION

The objectives toward which the Atomic Energy Commission's biomedical program has been directed since its inception are:

1. To exploit nuclear radiation and radioactive materials in the study of basic biological processes. Special emphasis is given to improving and developing techniques for the use of radiations and radioactive materials in medical diagnosis and therapy.
2. To increase knowledge of the biological effects of ionizing radiation in order to provide an understanding of the mechanisms by which radiation injury is produced and to provide basic information for those concerned with developing radiation standards.
3. To obtain information which can be used to minimize exposures to radiation in atomic energy operations or to protect against its biological effects.
4. To develop information of a toxicological nature on those chemicals unique to the atomic energy program or being used in the program in unprecedented amounts, where existing information is inadequate for industrial hygiene needs.
5. To develop and encourage the use of radiations and of radioactive materials in agricultural research.

Descriptions of the many studies under way at Commission laboratories or accomplished through research contracts with outside institutions are included in a later section entitled, "Biology and Medicine Research Program."

Training Activities

Although training is not strictly speaking a part of research and development it is closely related and is important to the necessary production of nuclear scientists. In recognition of the shortage of training facilities in nuclear energy, the Commission and its laboratories have developed a training program designed to provide trained personnel in numbers adequate to meet the future requirements of the national nuclear energy program. This program is discussed more fully in another section of this report.

International Activities

It is AEC policy that the results of research conducted by its contractors be reported fully and promptly to the AEC. It is also AEC policy to authorize and encourage its employees and contractors to submit their unclassified research findings to established scientific and technical journals for publication. Only in this way can the vast amount of information being generated in the program be brought to the attention of scientists in this country and abroad.

In addition to the regular standard distribution of all unclassified AEC reports, the Commission has taken other steps to assure wide

dissemination of information. These include: publication of Nuclear Science Abstracts, the only complete abstracting service on atomic energy; maintenance of depository libraries, both in this country and in foreign countries, where unclassified AEC reports are available for reference; and issuance of special reports, press releases and speeches. Finally, a very special instrument in making research results available is the international meeting. Such conferences have continually added to the spirit of international cooperation and friendly exchange of ideas. Small informal conferences held during the formal conferences amplify knowledge presented at the formal session. The value of these contacts to the individual scientist who participates is inestimable. Thus all of the work fostered by the AEC comes to fruition when it is made available to scientists throughout the world.

Research Contracts in Foreign Countries and Territories

To date the Atomic Energy Commission has not been engaged in a substantial foreign research support program, although under its authority the support of such projects under certain circumstances is permissible. Therefore the foreign research projects listed below were approved for AEC support by virtue of the uniqueness of their research contribution or because they fulfilled a Commission research need not otherwise readily available in the United States. This international approach to research problems is, of course, mutually advantageous and opens avenues of investigation of inestimable value.

Research projects currently supported by the Division of Biology and Medicine in foreign countries and territories cover a wide range including plant genetics and biochemistry, human and population genetics, marine biology, meteorology, and measurements of environmental radiation. Total annual support currently approximates $250,000. These projects are all directly supported by the U.S. Atomic Energy Commission. However, it is worthy of note that an expanded program of international research support through the International Atomic Energy Agency is presently under negotiation. A number of research contracts currently directly supported by the AEC are listed below.

Country and Institution	Investigator	Title
AUSTRIA		
International Atomic Energy Agency, Vienna, Austria.	.....	Development of Methods for the Enrichment of Calcium-46 for the Production of Calcium-47.
BERMUDA		
Bermuda Biological Station for Research, Inc., St. George's West, Bermuda.	C. L. Markert	Metabolic Changes During Development and Growth in Marine Invertebrates.
Do	J. H. Ryther	The Plankton Ecology and Related Chemistry and Hydrography of the Sargasso Sea.

Country and Institution	Investigator	Title
BRAZIL		
Catholic University of Rio de Janeiro, Rio de Janeiro, Brazil.	Father Francis X. Roser	Loan of Radioactivity Counting Equipment in Return for Reports on Analyses of Environmental Radioactivity Samples.
COSTA RICA		
Inter-American Institute of Agricultural Sciences, Turrialba, Costa Rica.	P. H. Emmett, R. H. Allee.	Atomic Energy Applied to Agriculture in Latin America: (a) Use of Isotopes, (b) Gamma Field.
ISRAEL		
The Weizmann Institute, Rehovoth, Israel.	Aharon Nir	Tritium Concentrations in Natural Water Sources in Western Mediterranean Area.
ITALY		
Naples Zoological Station, Naples, Italy.	Peter Dohrn	Radiochemical Techniques in Marine Biological Research.
Pavia, University of Pavia, Italy	A. A. Buzzati-Traverso, L. L. Cavalli-Sforza.	Mutation Rates and Mutational Loads in Man.
NEW ZEALAND		
Department of Scientific and Industrial Research Division of Nuclear Sciences, Lower Hutt, New Zealand.	T. A. Rafter	The Estimation of Sr-90, Ba-140 and Possibly Cs-137, in Every Rain in Gracefield, New Zealand.
URUGUAY		
Montevideo, University of Montevideo, Uruguay.	J. B. Totter, M. A. Patetta-Quelrolo.	A Study of the Origin of Precursors of Desoxyribonucleic Acid Purines and Pyrimidines in Bone Marrow.

Biology and Medicine Research Program

The Commission's current program in biomedical research was designed to meet the changing needs of the Atomic Energy Commission in fulfilling its responsibilities under the Atomic Energy Act of 1954 as amended to assure that the Commission's expanding operations are carried out with full regard for the public safety, and to continue to exploit nuclear energy and its byproducts in biomedical research for the welfare of the country.

During 1959, the first land-based prototype nuclear propulsion unit for rockets has been successfully tested in Nevada. Other nuclear propulsion prototypes for our National space and atmospheric transport program will probably be tested in the coming months. In other words, the potential for radioactive contamination of the atmosphere grows rather than diminishes and the need for better estimating the hazard and for developing the means for its control have grown.

As more and more nuclear propelled ships are commissioned the studies of fission product movement, concentration and turnover in the oceans and other waterways become more urgent as was indicated by the recent report of the National Academy of Sciences Committee on Oceanography.

The problem of fission product toxicity increases as we learn more about the behavior of these radioelements. Consequently, this aspect of our program, especially as it relates to mixed fission products, will expand with renewed emphasis on inhalation as a mode of entry into the body.

The past year in both the genetic effects field and in the cancer effects field evidence has come to light indicating a dose rate relationship to the effect produced. These observations are being expanded and carried further as rapidly as scientific manpower becomes available until a completely sound basis for setting acceptable levels of exposure of both industrial workers and the public as a whole has been achieved. Meanwhile efforts are being intensified to understand the basic mechanisms involved at the molecular level following the initial ionizing event.

The program of leadership in exploiting the beneficial uses of atomic energy in biology and medicine continues, calling for fuller utilization of the Brookhaven National Laboratory medical center, the Brookhaven National Laboratory sciences program and the University of California experimental treatment of cancer with the 184-inch cyclotron.

RADIATION EFFECTS ON BIOLOGICAL SYSTEMS

Medical Research

Medical research in this area is intended to provide a better grasp of the effects of radiation on plants, animals and man so as to be able to estimate more precisely the radiation hazard to people.

Studies on internal emitters—radioactive isotopes deposited in tissues within the organism—now cover the whole range of laboratory animals and include man himself. These isotopes are chiefly tritium, carbon-14, phosphorous-32, sulfur-35, calcium-45, strontium-85, strontium-89, strontium-90, yttrium-90, iodine-131, cesium-137, radium-226, radium-228, uranium-235, uranium-238, plutonium-239 and certain elements in the thorium and rare earth series which come under scrutiny because they are a product of fission or are hazardous to atomic energy operations. Such researches are components of a continuing program whose object is to be able to recognize and measure the local and distant radiation effects of such radioactive deposits and to relate these effects to the clinical status of persons who might be exposed to one or more of these elements. Further refinements of these studies are expected to demonstrate those concentrations of radioisotopes which produce no or statistically negligible effects.

These studies are being expanded to systematic medical observations of human subjects. In addition to the surviving watch dial painters exposed to radium-226 and/or radium-228, there are groups of industrial workers who are carrying varying amounts of plutonium-239, uranium-238 and uranium-235 in their bodies; it is expected that others will pick up radioisotopes of thorium and other elements currently be-

ing utilized in the atomic energy industry. These are being studied by the controlled low level facility (whole body counter) and by whatever detailed radiochemical procedures are applicable to samples of tissues, expired air and excretae.

Data currently available clearly indicate that the biologic behavior of many of the above radioisotopes in animals differs from that in man and hence studies of this behavior in man are being expanded both opportunistically and by planned controlled experiment. The whole body counter is the key equipment used for such planned studies and the further development and use of this equipment is being supported wherever the talents and intents of a group of investigators warrant such an installation. A byproduct of such planned experiments is that over long periods will come the data, ratios and factors correlating body burden with intake of activity in foods and water and/or with rates and absolute amounts of activity in the excretae. Such figures are needed to specify realistically the values for Maximum Permissible Concentration and Maximum Permissible Level published by the National Committee on Radiation Protection and Measurements in NBS Handbooks.

Studies of the effects of irradiation of the nervous system are being expanded following claims by foreign radiobiologists that the nervous system functioned differently following very low doses of radiation. This has not been corroborated thus far but work is continuing to obtain additional data on this very crucial question. Observations on the local effects of heavy particle irradiation from cosmic rays, the 900 MEV alpha accelerator, the boron-10 (n, alpha) lithium-7 reaction will supplement and extend the studies using conventional irradiation. Additional research is directed to the development of new methods for measuring the neurologic changes following irradiation since the conventional histologic and physiologic methods have not proved sufficiently sensitive to identify subtle changes. Such new techniques are expected to become available as a result of sophisticated neuropharmacological and electroencephalographic experiments now under way. Both central and peripheral nervous tissues will be investigated further for their probable reactions to irradiation.

Immunological studies continue to be directed toward understanding the suppression of tissue immunity induced by near-lethal doses of whole body radiation. This suppression of immunity has two concurrent effects; (a) it exaggerates the radiation syndrome by facilitating bacterial invasion followed by generalized infection and death; and (b) makes possible the acceptance of foreign bone marrow cells which will find their way to the host's depleted bone marrow and for a time at least be the source of working red and white blood cells. Major work in these fields centers around studies designed to: (a) identify the cell(s) involved in the host's immune reactions; (b) define the mechanisms by which tissue antigens cause these cells to produce the several types of antibodies; (c) describe the nature of these proteins and the way they are carried about in the blood and tissue spaces; and (d) discover what type of cells are best tolerated by the irradiated recipient.

Accidental near-lethal exposures of man fortunately have been too few to provide sufficient clinical material to carry out these experiments with the result that use will be made of every possible analo-

gous clinical condition which will give some hope of learning how to deal with this potentially lethal hemotological defect produced by whole-body radiation.

From these clinical studies should come data which combined with analogous data an animals will serve to complete the many gaps in our knowledge of the biological changes following potentially lethal doses of radiation. The Oak Ridge, Los Alamos, and Yugoslav accidents, although only a few persons were involved, have caused a major review of the biochemical changes after whole body exposures with the result that a number of new ideas and leads will be explored to the fullest extent permitted by facilities and personnel. Hopefully the studies and analyses will permit the identification of more of the multitudinous chemical and physiochemical changes taking place in tissues, organs, cells and subcellular units relative to different doses of radiation. Present researches will be extended to clinical biochemical tests capable of evaluating the biological seriousness of whole body radiation exposures in man. At the very least, it is anticipated that it will be possible to estimate absorbed rad dosage from neutron exposure from knowledge of activation of sodium-24 in the blood plus the spectral energy ranges of neutron flux.

The late or chronic effects of prior irradiation continue to receive significant attention but because of the necessity of observing animals (and man) throughout their life spans, the progress of such studies is slow. The results from experiments now in progress are expected to fill in more qualitative and perhaps some quantitative details of the recognized gross effects of significant amounts of whole body exposure, namely, carcinogenesis, leukemogenesis, cataract formation, nephrosclerosis, and accelerated aging with shortened life span. These aspects are being correlated with other studies on the aging process of populations such as the epidemiology of natural aging and the effects of variations in normal radiation background.

The experiments in progress include both total and fractional, single and repeated external exposures by gamma rays and neutrons, together with various doses and types of internal exposures as obtained by a variety of radioactive isotopes. The studies of the late effects of irradiation on the populations of Nagasaki and Hiroshima by the Atomic Bomb Casualty Commission is an excellent prototype of the kind of long term experiments required to investigate "chronic effects." Wherever possible the animal experiments have been planned so as to simulate situations which have occurred or may arise with respect to man.

Studies of pulsed radiation, a new line of research made possible by recent advances in engineering and design is planned in which the key element is a pulse of radiation—fast neutrons or 300 kev x-rays—produced within 1 millionth to 1 thousandth of a second. Practically nothing is known of the biologic effects or effectiveness of a practically instantaneous pulse of pure electromagnetic and particle radiations and thus it cannot be predicted what the significance of the findings will be. At the very least, however, all current theories of the effects of ionizing radiation on animate and inanimate objects must be tested against the results secured when the same amount of radiant energy is delivered to the object within about one-millionth of the conventional time of experimental exposure. From the practical

standpoint the dosimetry of brief-pulses of radiation can now be studied and developed as well as the behavior of certain components such as transistors, radiotubes, and detector components under these conditions. This line of research is long overdue for intensive investigation, but up to now the physical radiation sources have not been available.

Biological Research

Much of the past research effort in this activity has been concerned with two very critical problems in radiobiology: (a) improving the physical measurements of the dose absorbed from both external radiation and internally deposited radioisotopes; and (b) quantitatively determining the biological changes (such as mutations, tumor formation, cataract formation, death, etc.) which appear hours, days, weeks, months, or even years later. However, the accumulating knowledge from these studies has demonstrated that even in cases where there are good measurements of the dose neither the extent of the resulting biological change nor the exact time of its onset can be precisely predicted. This is of course not surprising because individual biological changes are undoubtedly initiated by different biochemical events. As this fact has become more obvious in recent years an increasing effort has been directed toward more fundamental studies of the biophysical and biochemical effects of radiation.

Biochemical studies of radiation damage.—From past studies it is known that as much as one million roentgens are required to produce appreciable "inactivation" of a specific biochemical in either the dry state or in a solution containing a number of other biochemicals—such as would be present in a cell. Yet, one thousand roentgens or less may be adequate to kill a significant number of some organisms or individual cells. Numerous explanations of this thousand-fold disparity have been advanced and are under investigation: for example,

(a) radiation destroys certain critical cellular components of which there is only "one-of-a-kind" per cell; or

(b) radiation-produced disturbances in the delicately balanced cellular metabolism become amplified; or

(c) radiation either produces poisonous products or else modifies the internal structure and cellular wall so as to allow essential compounds to leak out or poisonous compounds to get in; or

(d) the mechanisms of energy-interchange within biological systems is such that absorbed energy is "funneled" to critical sites.

Work is in progress in all of these areas and a continuing expansion in each is necessary to provide a better understanding of the basic nature of radiation damage. Critical cellular components such as enzymes and nucleic acids have been purified and their response to radiation studied. A large increase in emphasis is being placed on investigations of how the radiosensitivity of individual cell components varies depending upon whether they are irradiated inside the cell or completely isolated from it.

Intermediate cellular events.—Most radiobiological research has been concerned either with physical measurements of the absorption events which occur in the first 10^{-12} (one millionth of a millionth) seconds or with determinations of biological effects which appear quite some time after exposure. The problems which have evolved from these studies

show the need for knowledge of the processes occurring in the "in-between" time range: As a result, much of the present effort, as well as that planned, is directed at studies of the cellular events which occur in the first few minutes or hours. However, increase will occur in studies of those processes which occur in the even more restricted time region of 10^{-9} (one thousandth of a millionth) to 1 second after the absorption of energy. It is expected that knowledge of the mechanisms involved will permit an understanding of how cellular structures mediate the movement of energy absorbed from ionizing radiation from its point of initial absorption to critical sites within the cell.

Genetic damage from external radiation.—The genetic materials are critical cellular components which are fairly susceptible to ionizing radiation. Major research emphasis in this area is the development of genetic data necessary to provide an accurate estimate of the radiation genetic hazard to man. The expression and elimination of detrimental mutations in human populations is not well understood and conflicting hypotheses of the genetic structure of populations presently exist. An expansion is planned for studies designed to trace the accumulation, manifestation and ultimate elimination of radiation induced mutations in populations. These can be carried out with suitable laboratory plant and animal species and, wherever feasible, human populations are being surveyed.

Efforts are being made to improve knowledge of the selection pressures that act on human populations and the effects of these pressures in determining the frequency or incidence of detrimental mutations. Some mutations may appear in direct proportion to the mutation rate while others may accumulate to levels far in excess of what could be attributed to spontaneous mutation alone since they may confer some selective advantage to the carrier. It appears possible that a portion of the tangible genetic defects we see in man may behave in this manner. Continued studies of children of consanguineous marriage is vital for estimations of the mutation load normally present in man.

Many mutations have a subtle detrimental effect; for example, they may reduce growth rate, increase disease susceptibility, reduce reproductive performance or reduce the life expectancy. Existing programs, such as the Oak Ridge National Laboratory mouse genetics and the Iowa State College swine genetics programs, will contribute to understanding of these less tangible forms of genetic injury.

The Oak Ridge mouse genetics studies have demonstrated that continuous radiation exposure at low intensities is significantly less mutagenic than exposures delivered acutely. This is extremely important for considerations of the effect of occupational and environmental radiation hazards and emphasizes the need to understand better the chemical nature of genetic material and the manner in which radiation acts to change it. The lesser mutagenic effect of low intensity radiation provides new leads on the study to determine means of preventing or ameliorating genetic damage.

Investigations of the variations in radiation induced and spontaneous mutation rates in different species, at different stages of development, and under different physiological conditions are continuing. Radiation exposure produces considerable damage to the chromosomes as well as to the genes they carry. Chromosome damage is probably ultimately responsible for most cell death in irradiated

tissues and for most early-acting genetic lethality in embryos. Studies on this aspect of radiation genetic change continue.

Genetic damage from internal radiation sources.—Neither the genetic nor the somatic effects of radiation damage arising from ingested radioactive materials have been critically evaluated insofar as their respective contributions to the damage are concerned. This damage could arise from the radiation given off by the decaying nuclide or it could rise because of the breaking of a chemical bond upon the transmutation of the radioactive element during decay. Studies are designed to evaluate these two mechanisms, especially in comparing the relative effects of the radiation damage and the damage due to transmutation. These studies are particularly important since at least two common radioactive elements, carbon-14 and phosphorus-32, are constituents of genetic material.

Large animal studies.—Most of our knowledge to date concerning the biological effects of radiation has been developed from research on small laboratory animals. Experience gained from these studies is being applied with increasing emphasis to defining more clearly the pathological and physiological effects of radiation in larger domestic animals. Experimental data derived from larger animals can frequently be extrapolated directly to man because of closer similarities in body sizes, organ systems, and the voluminous data on breeding and performance records. Specific biological responses that require quantitating are hemotopoietic and gastro-intestinal injury, carcinogenesis, cataractogenesis, effects on endocrine and immune systems, effects on fertility, sterility and progeny, life shortening and decrement in physiological performance.

Biophysics Research.—Radiological physics and dosimetry is the study of the effects of radiation on matter. The principal purpose of the research in this activity continues to be the development of techniques and methods for measuring radiation in order that interpretation of possible damaging effects of radiation on man can be made. The following projects in radiological physics are being supported: (1) the continuing study of the slowing down of electrons in metals, (2) calculation of neutron dose in various phantoms and estimation of neutron dose to tissue and neutron induced activation of blood sodium, (3) study of the attenuation of neutrons and gamma rays, (4) electron capture and agitation experiments with particular emphasis on energy and charge transfer in ion-molecule collisions, (5) measurement of stopping power of low energy (below 10 kev) electrons in very thin metal foils and in tissue-equivalent plastics, (6) studies of ultraviolet light output of irradiated materials, (7) measurement of cross sections for energy transfer to solid media from high-energy particle beams, (8) further studies and development of neutron dosimetry techniques including proportional counter studies.

Environmental Sciences

Expansion in studies of radiation effects using terrestrial and aquatic plant and animal populations is taking place.

The construction of reactors, disposal of radioactive materials in areas away from human habitation, and other environmental radiation have placed emphasis on the need for investigations concerning indirect effects of radiation on man. Radioactive byproducts of atomic operations intensify one factor in the environment and this in

turn may alter others, notably those of a biological character, which in turn affect the total environment of man as well as the environments of plants and animals which produce food and raw materials essential to his living. Present studies are being expanded to develop data concerning (1) background radiation levels in uncontaminated areas (2) effects of prolonged low level radiation on native populations of organisms and (3) establishment of specific effects of various radiation doses on plants and animals that may serve to distinguish between the effects of radiation and of other somatic or genetic changes.

Projects will be continued toward the establishment of background levels of radiation in sites proposed for reactors and other nuclear installations. Observations will be increased of natural trends, periodicities and fluctuations of the biotic populations and environmental complexes in reserve areas of landscapes characterized by grass, coniferous forest, deciduous forest, desert shrub and woodland. These areas will serve as points of reference for studies of possible contamination in the future. Populations of organisms exposed to radiation will be studied intensively at Rongelap Atoll and in other areas where past detonation studies may document the succession of organisms in areas that were exposed to considerable radiation. Studies of long-term effects of radiation on populations in aquatic and terrestrial environments, whether natural or man modified, will represent a continuing increased effort.

COMBATING RADIATION DETRIMENTAL EFFECTS

Medical Research

Chemical protection.—The nature of problems of combating the detrimental effects of ionizing radiation in living systems are largely determined by the amount and quality of the radiation. Laboratory animals have been protected from lethal doses of external gamma and neutron irradiation using the organic chemical compound AET (S,2 aminoethyisothiuronium·Br·HBr) and several other similar compounds given immediately preceding radiation exposure. However, these compounds are less effective in rats and monkeys, because toxic effects of the drug cancel out the protective action. There also is a definite limit to the range of dosage where they exert a protective action.

Until recently, it has not been possible to administer a protective dose of AET (S,2 aminoethyisothiuronium·Br·HBr) to a dog. The toxic reactions have been decreased, however, by using different routes and methods of administration; these techniques remain to be investigated in man. The search for new types of compounds will continue and all promising leads will be explored.

Bone marrow transplantation has been shown to be extremely effective in promoting the recovery of mice from acute radiation injury. The first trials in dogs and monkeys were not encouraging. During the past year the development of more sophisticated techniques has unquestionably established successful bone marrow transplants in irradiated dogs. The success of the treatment in dogs demands continued investigation of methods of application to human subjects. A major line of study will be the possible utilization of fetal bone marrow for transplants.

One method of attacking this problem in humans is to attempt to treat leukemia by irradiating the entire body of the patient with the hope of destroying the diseased marrow and then replacing it with healthy transfused marrow. No permanently successful cures have been achieved. On the other hand, the patients with anemias who have not responded to conventional therapy, have in many cases shown dramatic improvement following bone marrow infusions. These results remain to be confirmed by other investigations.

Other organ transplants.—Radiation has been employed in attempts to modify the rejection of transplanted organs, for example the kidney. Prior to this use of radiation, the only successful transplants in patients have been carried out with tissue obtained from an identical twin, but now the pretreatment of a patient with a large dose of gamma radiation delivered to the whole body, and with supporting bone marrow therapy, is encouraging surgeons in their attempts to evolve a successful transplantation technique which overcomes the immune defenses of the human body. Studies will continue to provide information in the immunological reactions of transplanted marrow in the human host, the selection and processing of human marrow and the preservation and evaluation of frozen or otherwise preserved marrow.

Removal of radionuclides from the body.—The other major source of damaging radiation to the human body, internal emitters, is of interest from the industrial standpoint. Accidental ingestion and inhalation of radioactive materials occur in nuclear manufacturing and processing operations. Other radiation incidents may on occasions provide a hazard to the general population. Accurate and rapid estimation of the radioactivity retained by the body is necessary for proper treatment of the patient. Methods increasing the excretion of the ingested isotope have been worked out for several elements. However, no effective technique has been established for decreasing the body burden of many of the bone seeking elements, such as strontium-90. Synthesis and testing of new chelating agents for this purpose will continue. It is expected that studies of the physiological and biochemical mechanisms controlling metabolism of mineral elements may subsequently lead to more useful methods of decontamination.

Modifying delayed effects.—The delayed effects of sublethal doses of radiation as well as effects caused by long exposure to low levels of radiation have received increased attention during the past several years. Projects for the study of radiation mortality are under way to determine whether treatment with anti-radiation drugs, or dietary factors will modify or delay the appearance of the last effects, such as life shortening, carcinogenesis and kidney damage.

Biological Research

Increasing evidence of the wide variations in the sensitivity of different organisms to radiation damage is accumulating. Thus some organisms show an observable effect after receiving 0.1 roentgen of ionizing radiation whereas others can grow in the water used as a moderator in a reactor where they may receive as much as one million roentgens. Studies of the fundamental biochemical and biophysical mechanisms underlying this "tolerance" of radiation by some organisms may well lead to the discovery of substances which will offer pro-

tection against radiation damage. It seems particularly important to investigate these phenomena at all levels, i.e., at the sub-cellular, the cellular and the organ system as well as at the level of the whole organism; research is carried out in the following areas:

(1) Since little is known of the biochemical processes occuring during recovery from sub-lethal doses of radiation, studies of this important area are expected to be of value in developing substances to accelerate recovery or to prevent damage from radiation.

(2) Studies are being conducted on methods of removing or of preventing the uptake of internally ingested radionuclides, in particular, studies concerned with factors which influence the absorption of strontium and cesium from the intestine either by complexing with them or in some other way preventing their uptake.

(3) Attempts are being made to determine more precisely the importance of genetic damage to somatic cells in causing cellular death.

(4) Biological research is being carried out on the immunological responses of irradiated animals and tissues. Research is needed not only on the difficulties resulting from immunological responses encountered during bone marrow transplantation but also on the changes in immunity to other substances of biological importance resulting from radiation damage. New long term projects are being initiated utilizing large domestic animals to study the radiotherapeutic value of bone marrow and other tissue extracts and related immunological factors. Some progress has already been reported in the use of autologous bone marrow transplantation in cattle and chemical radioprotectants have proved effective in small laboratory animals. Results of these studies may be directly applicable to man.

(5) Efforts are being devoted to the development of radioprotective drugs that afford protection and also have a low toxicity. Important leads for synthesis of drugs in the future may come from studies on substances occuring naturally in the body that appear to counteract radiation damage.

(6) Emphasis is being placed on determining the biochemical nature of the enhancement of X-ray induced breakage of macromolecules and structures such as the chromosome by far-red light and the reversal of this enhancement by red light. These studies are expected to lead to a better understanding of the mechanisms involved in early stages of radiation damage.

BENEFICIAL APPLICATIONS OF ATOMIC ENERGY

Cancer research

The construction of previously planned facilities, including high energy ion accelerators for use in the cancer research program, has reached completion. Consequently the operational level and the tempo of the research effort is increasing.

The recently completed medical reactor at Brookhaven National Laboratory provides a tool which will have far-reaching effects on the treatment of certain malignant brain tumors, and research is being conducted to explore its potential usefulness in other types of malignancies. The patient load of 48 beds will reach full capacity by next summer.

Other radiotherapeutic studies are continuing at the Oak Ridge Institute of Nuclear Studies with both cesium and cobalt units. In addition the newly constructed irradiation facility for the total body irradiation of leukemias followed by bone marrow infusion will be functional in the near future. From such a study information will be gained not only pertaining to therapy of leukemia patients, but also to the problems associated with organ grafts, including skin grafts.

Additional radiotherapeutic research centers around the 70 Mev synchrotron at the University of California Medical School in San Francisco. Here the effects of high energy x-rays in the treatment of selected tumors (lung, cervix, tongue, and bladder) are being studied in human patients. To date the number of patients treated is too small and the elapsed time too short to permit any final conclusion as to the place this device is to take in the treatment of cancer.

At the Argonne Cancer Research Hospital cancer patients continue to receive deep therapy from both the 2 Mev Van de Graaf and the 2800-curie cobalt source. The recently completed 50 Mev linear accelerator at the Argonne Cancer Research Hospital represents a new approach to electron therapy in that the electron energy can be varied. The emergent beam in this particular unit can be adjusted to between 5 and 50 Mev. In addition to the variable energy, this unit is equipped with a magnetic deflecting and scanning unit which provides variability in beam direction and treatment area required in practical radiation therapy. Patient treatment has begun on patients with head and neck tumors and will be extended to other types when the capabilities of the instrument are better understood.

Irradiation of the pituitary gland, using the proton beam of the 184-inch cyclotron at the Lawrence Radiation Laboratory, will be continued in patients with advanced breast cancer. Although the application of this technique has limitations, results to date have been sufficiently encouraging to continue research efforts in this area.

Development of various brachytherapy devices continues. Clinical and experimental work continues with the various soft x-ray emitting type isotopes which have been found to be well suited as a means of delivering interstitial radiation for the treatment of malignancies. Among them palladium-103 has been used to treat several patients with advanced tumors; yttrium-90 is still being used with success to destroy the hypophysis of patients who have metastatic carcinoma of the breast; and iodine-131 encased in polyethylene applicators has been implanted in patients with inoperable carcinomas.

Supporting these clinical applications are studies directed toward the refinement of techniques and instrumentation concerned with more precise detection and localization of tumor masses. The use of the positron-emitting isotopes (i.e. astatine-74, manganese-52, and copper-64) and also such gamma-emitting isotopes as iodine-131 will continue to be explored in brain tumors as well as other type malignancies, including metastatic growths. It is hoped that calcium-47 will be available soon; this isotope will have useful application in bone metastases. Further development of mobile and "area" scanning devices are being pursued.

It is expected that the red blood cell stimulating substance, "erythropoietin," will become available for clinical trials. This substance

promises to be most effective in treating certain refractory anemias sometimes seen in cancer patients, for which there is no treatment other than transfusion at the present time. It also offers potential in the treatment of blood conditions wherein blood formation is suppressed, as in radiation sickness.

Studies continue on the effectiveness of triiodothyronine in potentiating the biological action of ionizing radiation. The use of triiodothyronine in conjunction with radiation in the control and ablation of various tumors has been found to be effective both in clinical patients and in experimental animals, although some toxicity has been noted in patients subjected to long treatment. Refinement of this technique continues.

Immunologic studies are receiving continued emphasis. Further study of the recently initiated attempt to treat cancer of the thyroid by an immunologic attack on the antigen in thyroglobulin is under way. In addition, fundamental studies directed toward determining the earliest link in the chain of events leading to immunologic rejection of grafts of foreign tissue are being pursued.

Rather extensive metabolic studies continue in both normal and cancer patients, as well as in animals, following the administration of metabolically important substances labeled with carbon-14. The excretion patterns are being followed to detect changes that occur in cancerous conditions, as well as following whole body radiation injury.

Studies in both radiation and chemical carcinogenesis also continue.

Medical Research

Investigations are conducted of the use of radioactively labeled compounds in biochemical and biophysical studies of normal and disease processes in men and experimental animals. Tritium, for example, is being used increasingly to determine the performance capacity and durability of various cellular and tissue components. Incorporation of this and other isotopes into compounds involved in cyclic metabolic chains, reveals problems of deficiencies, abnormal rates and improper balances in complex biologic systems. The ability of cells to replicate critical components, their rates of cell division under different conditions of disease, and their abilities to repair and regenerate subsequent to damage of various kinds, are types of studies under way.

Experiments designed to influence the source of disease by unique applications of radiation are continuing especially in those situations where the disease presents a ready made opportunity for experimental study. Carbohydrate metabolism in the diabetic human and in experimental animals is an example. Such metabolism is closely related to protein and fat metabolism in various tissues and may be influenced or controlled by the nervous and endocrine systems. Continuing analytical investigations provide increasingly critical data, which in turn enables more effective treatment of disease.

Carbon-14 labeled fatty acids and cholesterol have been administered to animals in the study of developing lipoid materials found in the arterial plaques associated with atherosclerosis. Furthermore, the physico-chemical characterization of fatty macromolecules have been studied in relation to other metabolic diseases, including the chronic effects of radiation on lipoprotein metabolism. Results to date indicate that this work is very promising.

The utility and value of fresh whole blood, blood platelet preparations, and lyophilized platelets for the treatment of blood diseases in which bleeding occurs has been under investigation in relation to various clinical diseases for several years. Progress has been made and remaining potentialities appear significant. Studies are using more advanced labeling techniques for different kinds of cells. Such studies are expected to provide a more complete understanding of occurrences when different cell types are transfused—that is, how they survive, function and multiply in relation to host cells. Carbon-14 labeling is the basis for continuing research in metabolic diseases just as iron-59 labeling of hemoglobin has been and continues to be the foundation for studies of diseases that affect red blood formation.

Tritium labeled thymidine also has been found especially valuable in studies of the origin, function, migration, proliferative rate and survival of different types of blood cells, and other cells. Research is expected to extend the application of these useful analytical procedures to a further understanding of basic biological processes.

Biological Research

Research in this area is designed to exploit as fully as possible the beneficial applications of radiation and radioactive isotopes in the fields of biology and agriculture. Radioactive isotopes represent some of the most powerful tools developed by science for the study and elucidation of the incredibly complex processes and reactions upon which life is based. Isotope techniques permit a better understanding of many agricultural problems, and such understanding results in improving the nutritional status of the world's population.

The recognized and vitally important role of the Atomic Energy Commission in fundamental studies on the application of tracer and radiation techniques in agriculture is resulting in valuable information for general application. Areas of research in which efforts continue are farm animal nutrition and metabolism, invertebrate parasites of farm animals, insect biochemistry and physiology, and studies of the basic aspects of soil chemistry. Workers in plant physiology, biochemistry and genetics have rapidly adapted isotope techniques to their research. Such application has not taken place in the field of plant pathology; therefore this area of research will be pursued. Studies on plant metabolism and radiation genetics are being expanded to include further work on tropical farms because of the necessity of increasing agricultural productivity in most of the areas where such plants are raised. Finally, research continues on the physiological genetics of higher plants in order to develop more useful plant varieties.

Considerably more information is required on the structure, synthesis and control of synthesis of large molecules of biological importance, such as proteins and nucleic acids. It appears certain from recent experimental evidence that radiation-produced mutations do not become "fixed" immediately except under rather specific conditions. Thus it appears that the "fixation" occurs only if the cell is actively growing and synthesizing protein and nucleic acids. The mechanisms of protein, ribonucleic acid and deoxyribonucleic acid biosynthesis, a determination of their structures and functions and particularly the interrelations between them are essential to the under-

standing of radiation damage both from a genetic and a non-genetic standpoint. Such studies should permit an understanding of the interrelationships of ribonucleic acid, deoxyribonucleic acid, and protein metabolism as they relate to gene mutation and other damage from ionizing radiations.

Studies on the basic mechanisms of energy absorption, conversion, storage and transport in photosynthesis and other photochemical processes in biological and model systems provided information useful for the interpretation of the similar, but little understood processes involving ionizing radiation. Studies of the fundamental biochemistry and physiology of living material using radiation and radioactive tracer techniques are dependent upon a considerably better understanding of the chemistry and physiology of normal living cells and organisms to establish (a) the mechanisms of ionizing radiation injury and (b) rational approaches to the prevention and alleviation of damage from ionizing radiation.

Development techniques utilizing radiation and radioactive tracers in general biological research are being emphasized. Techniques of particular utility include the use of oxygen–18 for metabolic tracing of oxygen followed by conversion to fluorine–18 by neutron activation to make its detection possible by routine counting procedures.

Environmental Sciences

Ecological research in this area is directed toward the development of appropriate techniques for studies of the dynamics of exchange of minerals in a growing community of plants and animals.

Determinations are being made of the importance of iron, calcium, phosphorus, zinc, cesium, strontium, sulfur and other elements in regulating the quantity of food produced in fresh water and in oceans and of the role of these elements in limiting such production. Information is being sought concerning the uptake of phosphorus-32 by various populations of organisms and the retention time of this isotope. Further elaboration of the fate of various isotopes in water is being explored. Various techniques are being developed for using radioactive elements to solve ecological problems such as the concentration of trace elements and their role in the life of various organisms. The dynamics of production in idle lands, in lakes of low productivity and in the oceans are being studied. Microclimatic studies are being conducted to develop a better understanding of the limits of existence of local communities of biota.

Certain field experiments to determine some basic facts such as rates of diffusion in standing water and the rates of flocculation and sedimentation of biologically important radiochemicals, are being performed. The migration patterns of a few economically important organisms are being studied by isotope tagging under controlled conditions. Techniques are being developed for using radioisotopes for tagging or for other methods of identifying individual organisms and populations in studies of ecosystems.

The potential production of large quantities of algae, which may be given as food for yeast and which in turn may be eaten by man, are under investigation in some laboratories using carbon-14 as a tool. Comparisons will be possible between quantities of organisms, their lengths of life and similar problems with carbon-14 techniques.

Distribution of Radioisotopes under Research Support Program

Radioisotopes are provided to research institutions for approved projects in the fields of medicine, biology and agriculture at an 80 per cent reduction from Atomic Energy Commission established prices.

BIOMEDICAL PROBLEMS IN ATOMIC ENERGY OPERATIONS

Medical Research

Atomic energy operations not only face hazards from external radiation sources but from numerous other potentially hazardous agents which may be deposited within the body and are therefore classified as internal radiation hazards. These cannot be dealt with by the expediency of shield construction but require prophylactic methods of inceptive hazard removal and actual removal from the body by chemical agents. Many of these hazards are associated with the mining, milling and concentration operations encountered in the procurement of raw materials and ores in the purification, fabrication and reprocessing operations found in the manufacture of nuclear fuels. Research must be conducted to evaluate these hazards, to set tolerance limits, and to develop protective and/or corrective methods to control or neutralize hazards. This information is being disseminated to the Division of Licensing and Regulation, the Division of Reactor Development and to Atomic Energy Commission contractors as well as other interested Government and non-Government organizations as rapidly as the research data become available.

An expanded program of investigation is planned relative to the potential hazards from fission product contamination resulting from reactor operations and a contaminating reactor accident. Not only are studies necessary on the hazards of radiotoxic elements connected with reactor operations, but similar studies must likewise be made to determine the toxicity of many non-radioactive elements now coming into prominence as components of reactor development and construction. Elements which were no more than laboratory curiosities a few years ago, are now being found to meet special requirements such as withstanding high temperatures and pressures in intense radiation fields for long periods of time without corrosion or other metallurgical damage. The acquisition of toxicity data must parallel the development on the technological effectiveness of the material. Research in the following areas is being conducted:

(1) An extensive screening followed by indicated acute and chronic toxicity studies on such elements as promethium, scandium, niobium, and europium, together with various alloys.

(2) A systematic study of the inhalation toxicity of the rare earth elements, including cerium, lanthanum, neodymium and praseodymium.

(3) A continuing study of the effect on the lungs and other organs of inhaled and non-radioactive particulates, particularly in relation to the possible production of lung cancer.

(4) The establishment of several low-level counting facilities strategically located in areas of uranium mining and production operations. These are to be used for monitoring uranium workers as well as being available for the investigation of industrial medical

problems in cooperation with State Public Health Agencies and medical schools.

(5) A program designed to study the inhalation, retention and metabolism of mixed fission products which may be released as the result of certain types of reactor failures, the operation of different types of airborne reactors and the composition of various types of SNAP projects, in collaboration with the Division of Reactor Development.

(6) Long-term followup studies of chronic beryllium and mercury exposure cases.

Biological Research

Biological research in this category deals with fundamental reactions in plant and animal systems resulting from various fission products arising from atomic energy operations. These studies continue to assume great importance with reference to increasing development of reactor powered vehicles and installations and consequent hazards of possible contamination of the environment with fission by-products. Special emphasis is directed toward studies concerning acute and chronic effects resulting from assimilation of fission products in soil and plant systems, and in animals resulting from ingestion of fission products through the food chain. Controlled studies utilizing small animals are being continued; however, the use of larger animals, especially farm animals, is being greatly expanded. The larger farm animals are important factors in the food chain for man.

In addition to studies concerning absorption, distribution, retention and excretion of fission products in animals, attention is being directed toward studies employing chelating agents and other methods to alter absorption, distribution and retention of radionuclides. Research concerning physical and chemical treatments of soils to reduce the availability of fission products to food crops and investigation of plants which might be utilized to reduce soil contamination are continuing.

Biophysics Research

The biophysics research program is concerned primarily with (1) health physics related to potential radiological hazards in and around plant and laboratory areas; (2) earth sciences as they relate to the disposal of radioactive wastes; and (3) dosimetric studies of maximum permissible body burdens and maximum permissible concentrations of radionuclides in air, water, or food. Studies of the physical, chemical and biochemical behavior of radioactive substances and toxic chemicals released to the environment by normal operations of Atomic Energy Commission installations continue.

A problem of fundamental importance is to provide low-level chemical and radiological methods for the determination of radioisotopes in waste streams, materials of the environment and biological fluids. These data provide the bases for radiological protection. Analytical procedures for transuranium elements in environmental material are being studied for suitability for routine analyses.

Additional studies are directed toward the disposal of intermediate and low activity liquid and solid wastes, particularly at Oak Ridge and Hanford. Most fission products exist as cations in aqueous wastes and can therefore be removed from solution by soil materials through

which they pass. Therefore, the physics and chemistry of soil disposal are being studied in order to take advantage of this capacity for removing radioactive cations.

Studies of maximum permissible body burdens and maximum permissible concentrations of radionuclides have been developed in conjunction with the Internal Dose Committees of the National and International Committees on Radiation Protection. These values are needed as guides for designing reactors, processing radioactive materials, and other developments in the use of atomic energy. In addition, maximum permissible concentration values are needed for questions related to the general population such as effects of discharge of radioactive effluents into the atmosphere and into water systems. The program includes the following: (1) analysis of human tissue for certain elements using the methods of emission spectrography and flame photometry, (2) analysis of human diets and excreta from metabolic balance studies, (3) collection and evaluation of biological and physical parameters useful in obtaining values of maximum permissible body burdens and maximum permissible concentrations of radionuclides, (4) obtaining data applicable to the determination of gonadal dose, and (5) studying the gastrointestinal tract histologically and autoradiographically for damage, especially by alpha emitters.

Environmental sciences

The program of worldwide monitoring of the land, sea and air will be expanded with more emphasis on (1) developing a balanced sampling network, utilizing improved techniques, for documentation of long-term changes and (2) cooperating with other Federal and State agencies in developing a more adequate capability for investigating local distribution and variations of environmental radiation. Increasing use will be made of the scientific information developed in the monitoring program to estimate the environmental contamination which can be expected from nuclear-powered space vehicles.

Studies of meteorological conditions in the vicinity of major Atomic Energy Commission facilities, tracer studies of the dilution of stack effluents in the atmosphere, and basic studies of turbulent diffusion are continuing.

Research projects in ecology are expanding in number and in scope as the utilization of atomic energy increases, and as developments produce potential contaminants for the environment. The cooling of reactors and of nuclear processing plants results in the release of small quantities of radioisotopes into the environment. A careful study of the organisms in the environment of nuclear facilities is being made to locate possible concentration of elements and to interpret the effects of any accidental release of radioactive materials.

Many of the radioelements that appear on land and fresh water will dissolve in running water and join the isotopes in the ocean. A substantial research program in the marine sciences is being supported to advance present knowledge of this contamination. The potential distribution of radioactivity from failure of propulsion units or accidents to nuclear submarines and nuclear airplanes will be studied.

Investigations are continuing of ocean currents and of the immediate and ultimate distribution of radioactivity by plants, animals, and sediments in the ocean. Background levels of radioactivity are being determined in order to provide baselines for studies of the effects of

operations of nuclear ships and other devices on life in the sea. Since the oceans contain a substantial amount of radioactive potassium, radium, thorium, and other radiochemicals, research on the relationship between normal and added radioactivity are being supported.

Studies are underway of the capacity of the environment to accept radioelements without adverse effect and of the factors that contribute to this acceptance. Investigations are being expanded to assess the genetic and physiological effects of radiation from Atomic Energy Commission facilities and from the use of nuclear devices to relieve such cultural problems as power production and mass excavation of harbors and channels. Expansion is needed in order to meet special problems concerned with peacetime applications of nuclear devices.

Studies are being made of the long-range effects of radiation on the environment of Commission installations. Studies of special problems of toxicity of radiochemicals to various species of organisms are being supported at Hanford, Oak Ridge, and other sites.

DOSIMETRY AND INSTRUMENTATION

The control of nuclear radiation hazards and quantitative experimental biomedical research are both dependent on the development of measurement systems and instrument equipment. The program of dosimetry and instrumentation has a twofold approach directed to the implementation of both radiation control and radiation research in biology and medicine. These are (1) special application of existing techniques to the many varied radiation hazard situations and to research experiments, and (2) a basic study aimed toward the discovery of new fundamental techniques for detecting each of the significant forms of nuclear radiations and development of these new techniques as useful instruments. Increased emphasis on biomedical research particularly as it relates to radiation protection is leading to development of instrumentation in the following areas.

1. Special problems in radiation protection arising from the varied operational environments throughout the Commission's plants and laboratories. Particular emphasis is being directed toward the development of radiation measurement techniques and equipment associated with the control of hazards arising from the new high energy accelerators in use or under construction. The application of transistor circuitry to radiation instrumentation is expected to improve reliability, serviceability and operational life of the equipment.

2. Low-level radiation detecting and counting equipment is becoming increasingly more important. The effort in this area is directed toward two phases: (a) the measurement and evaluation of external radiation at the natural terrestrial and cosmic ray background including quantitative measurement of the slight increases caused by environmental contamination and (b) the measurement of low level radioactivity in humans and foods, both natural and from other sources.

3. Recent problems arising in biomedical research on the effects of alpha, beta, gamma and neutron radiations, both individually and mixed, at the organ and cell levels require increased dosi-

metric instrumentation. Specific emphasis is being directed toward development of instruments for measuring the energy transfer from the irradiating particles to the cells along their path in order to study the mechanism of cell damage. Instrumentation to delineate the relative dose contribution in mixed gamma, slow and fast neutron fields is continuing.

4. Further research is directed toward the development of instruments for clinical and research applications. This includes development of an improved medical scanning spectrometer for localizing radioactivity used in diagnostic and therapeutic techniques; and development of small *in vivo* detectors to pinpoint beta emitters used as diagnostic tracers.

5. A significant new area of research is that of instrumentations for obtaining images of nuclear tracks in scintillation detectors. The technique requires development of special high gain image intensifier electronic tubes in which an image at exceedingly minute light levels is amplified sufficiently to be seen or photographed. This technique provides research workers with the capability of studying the behavior of single nuclear radiation tracks.

LETTER OF TRANSMITTAL FROM ATOMIC ENERGY COMMISSION

In your letter dated November 20, 1959, you requested a background paper on the "Isotope, Radiation, and Research Program of the United States."

With this letter I enclose a report "International Cooperation in Basic Research in the Physical Sciences" prepared by the Commission's Division of Research.

International Cooperation in Basic Research in the Physical Sciences

The U.S. AEC's program of basic research in the physical sciences seeks to discover natural laws relevant to the Commission's responsibilities for the development, use, and control of nuclear energy. Although the physical research program is purely domestic (i.e., the Commission presently has no contracts abroad for the conduct of basic research in the physical sciences) the scientific community is international. *Basic research is, by its very nature, international in character.* Scientific literature appears in most of the world's major languages, and is read by scientists all over the world. Wherever they go scientists speak a common language and have common bonds.

No one nation has exclusive jurisdiction over basic areas of science and much is to be gained through international cooperation in the exchange of scientific data and of the scientists themselves. Great scientific discoveries usually are not made in a vacuum, but rather are the culmination of many years of research by many scientists throughout the world. Even where such cooperation has been lacking, as has been the case until recently between scientists of the free world and Soviet bloc nations, it has been demonstrated that scientists of the individual nations inevitably arrive at substantially the same conclusions and results working independently of each other.

The major part of *international cooperation* in basic research takes place spontaneously within the scientific community itself. Scientific personnel, as part of their interests and responsibilities for keeping abreast of scientific development in general, attend many important formal or informal international conferences in the United States and abroad in their respective areas of specialty. National and international meetings and other discussions between scientists engaged in basic studies of the fundamental laws of nature are usually generated and organized by the scientists themselves and are not generally part of a detailed master plan directed from high administrative levels. Thus, a great share of international intercourse in basic research takes place outside of regular agreements and/or Government-sponsored conferences. However, due to the major role played by the Federal Government in the financing of university research, much of the cost

of this international scientific intercourse is borne by the Federal Government, including the AEC.

Such international cooperation takes many forms. University faculty members frequently spend their sabbatical leave abroad for study and information exchange. When at home, they often have foreign scientists working with them on their research projects. During 1959, more than 250 U.S. scientists who are engaged in AEC-sponsored basic research in the physical sciences traveled abroad in the interest of international scientific cooperation. Similarly, a great number of foreign scientists regularly visit the United States to participate in meetings, or to spend extended periods of time at one of the major AEC research centers.

In its move toward expanding and improving the capabilities of this country in the development and application of atomic energy to peaceful uses and of fostering cooperation with other countries so that information and benefits of atomic energy may be shared with other nations, the Commission continuously encourages international exchange of scientific and technical personnel, exchange of information pertinent to the development of peaceful uses of atomic energy, and training of foreign nationals in nuclear science and technology through courses, research, and work assignments in this country's universities, Government-owned laboratories, and other facilities.

Further details on the Commission's sponsorship of international conferences and concerning its information exchange and training and education programs appear elsewhere in chapter VI.

Nuclear cross section measurements

In addition to the cooperation and guidance the Commission receives from its Statutory Advisory Committees, the Commission has found it necessary and of great value to seek the advice and recommendations of special advisory bodies appointed to study and review problems and programs in specific areas of activity, such as reactor physics, medical uses of isotopes, industrial information, and others.

In the area of nuclear data or cross-section measurements, there are two standing advisory committees, one national and one international, with some members serving on both. The U.S. Nuclear Cross Sections Advisory Group makes a continuing review of the Commission's program of nuclear cross-section measurements, analyzes all available data, reviews the adequacy of existing programs, assists in the interchange of information and, where possible, initiates new measurement activities as required.

Since 1956, the Tripartite Nuclear Cross Sections Committee (TNCC), composed of British, Canadian, and U.S. scientists, has been doing a similar job on an international scale and has succeeded in establishing a close experimental collaboration between the United States, the United Kingdom, and Canada in the nuclear cross section measurement field.

The desirability of broadening this tri-nation cooperation has been expressed by the scientific community. Steps are being taken to establish a European-American Nuclear Data Committee (EANDC), designed to facilitate further general international information exchange and cooperation in this field.

High energy physics

Particularly interesting is the increased international cooperation that has developed lately in the fields of controlled thermonuclear research and in high energy physics.

In 1956, the Council for European Nuclear Research (CERN) held a Symposium on High Energy Accelerators and Pion Physics in Geneva, Switzerland, which was attended by some 200 of the world's leading high energy physicists, including about 50 from the United States.

In 1958, the regular University of Rochester Conferences on High Energy Nuclear Physics were put under the auspices of the International Union of Pure and Applied Physics (IUPAP), and plans were made to hold these annual conferences on a rotating basis in the United States, Europe, and the Soviet Union. The Eighth Annual Conference was held in Geneva in 1958, the Ninth in Kiev in 1959, and the Tenth is scheduled to be held at Rochester in 1960. U.S. participation in these conferences is sponsored by the Atomic Energy Commission, the National Science Foundation, the Office of Naval Research, the University of Rochester, local Rochester industries, and the International Union of Pure and Applied Physics.

One of the recommendations made by the special panel on high energy physics of the President's Science Advisory Committee and the Commission's General Advisory Committee was that the U.S. National Academy of Sciences be asked to make a study on the best method for proceeding with international cooperative research on new accelerator concepts, such cooperative activity to include the Soviet Union. In discussing such international collaboration, the panel stated:

> **The worldwide scientific significance of research in high energy physics, the extensive, high quality of scientific activity abroad in this field, and the limited number and costliness of high energy accelerators present a unique opportunity for a high degree of international collaboration and cooperation in the planning for and design of future accelerators and in the increased use of facilities. As a first step in the direction of international collaboration looking toward the development of new high energy accelerators, representative scientific groups from other countries, including the U.S.S.R., should be encouraged to meet with us in order to lay plans for cooperative research on new accelerator concepts. The National Academy of Sciences should be requested to advise on the best means for accomplishing this objective.**

The subject of establishment of further cooperation in the field of high energy accelerators and their use was brought before the IUPAP High Energy Commission at its meeting in Kiev in July 1959, and it was agreed that the matter should be taken up by a special IUPAP subcommittee to consist of three members from the United States, three members from the Soviet Union, and three members from Europe.

In September 1959, a IUPAP group of United States, European, and Soviet high energy physicists met in Geneva for further discussions of this matter. Although there was general agreement on behalf of the United States, European and Soviet physicists who took part in this meeting that increased international collaboration in this field was necessary and desirable, no formal actions or recommendations were made since it was recognized by all parties concerned that

such steps would have to be taken through formal government to government arrangements.

During the exchange of visits in the summer and fall of 1959 between high ranking United States and Soviet atomic energy scientists and Government officials, the need for cooperation in high energy physics was discussed. The possibility of constructing and operating joint accelerator projects was brought up. The Memorandum of Understanding, which was signed in November 1959 by the Chairman of the U.S. Atomic Energy Commission and the Head of the U.S.S.R. Main Administration for Utilization of Atomic Energy provides for initial exchanges of visits by scientific and technical personnel specialized in the fields of thermonuclear research, nuclear power reactors, high energy physics and nuclear physics, neutron physics, and the structure of the nucleus; exchange of documents, reports and abstracts; and the exploration of the feasibility of joint projects.

LETTER OF TRANSMITTAL FROM ATOMIC ENERGY COMMISSION

In one of your letters dated November 20, 1959, you requested a background paper on the "Research Reactor Assistance Programs of the U.S." This request was amplified in the course of the meeting with Mr. McKinney on January 6, 1960, to include a report on the "Equipment Assistance Program" and also a discussion of the utilization by cooperating countries of the reactors to which we have contributed financially.

I am happy to enclose two copies of a report on "The Research Reactor and Equipment Assistance Programs" which has been prepared by the Commission's Division of International Affairs and cleared in substance with the Department of State.

UNITED STATES
ATOMIC ENERGY COMMISSION

THE RESEARCH REACTOR AND EQUIPMENT ASSISTANCE PROGRAMS

A. The Importance of Research Reactors in the Foreign Program

When the "Atoms for Peace" program was initiated it was recognized that many nations of the world had not, as yet, acquired the knowledge, skills or technical talent that would permit them to perform research or derive the benefits from potential applications of nuclear energy in various fields. Accordingly, during the early stages of the international program it was believed that attention had to be devoted to providing foreign nationals with the basic or specialized training they needed to undertake further work in the nuclear field and assisting them in acquiring the facilities that were required to train personnel and permit the performance of research.

Serious consideration was given to various ways in which foreign nations could be assisted and encouraged to share in the peaceful applications of atomic energy. In the course of these discussions it was concluded that in addition to providing cooperating countries with extensive information, training opportunities, and materials such as radioisotopes, it would be desirable to provide them with assistance required to acquire and effectively utilize research reactors.

The use of small-scale research reactors was given particular emphasis because it was recognized that such facilities could be used for a multitude of purposes including training, teaching, basic research, medical therapy,

the production of radioisotopes, reactor engineering and reactor physics. Given the limited resources that many countries had available to apply to nuclear programs it was concluded that the provision of such facilities might provide foreign countries with an opportunity to acquire relatively diversified and basic experience in the nuclear field through the expenditure of relatively modest sums. In addition, although several countries had expressed an interest in ultimately constructing nuclear power plants it was noted that further development was required before such plants could be constructed with an assurance they would be economic, that they were complex and costly to build and operate and that, accordingly, it might be more prudent for many countries to initiate their programs with more modest research and training facilities.

In this context, the President in November 1954 approved the Commission's recommendation that 100 kilograms of U-235 be allocated for use in the operation of small-scale research reactors and for other research purposes in selected foreign countries. In addition, Ambassador Lodge in his statement before the United Nations on November 5, 1954:

a. stressed the many benefits to be derived from the use of research reactors, and their value as devices to train personnel to work on future power reactors;

b. indicated that the United States would be prepared to negotiate bilateral agreements with other countries which, under the Atomic Energy Act of 1954, would make it possible for the United States to furnish technical information, technical assistance, and the necessary amounts of fissionable material for the construction

and operation of research reactors to be located abroad;

c. announced the willingness of the United States to establish a Reactor Training School in 1955 which would be open to scientists and engineers from overseas;

d. indicated that training courses in the field of radiation safety and medicine would also be made available to foreign scientisits, and

e. announced that the U. S. would make comprehensive technical libraries available to cooperating nations.

Starting with the Agreement with Turkey, the United States, in the spring of 1955, negotiated a series of agreements for cooperation with other countries centered on providing other countries with the fuel, equipment, technical advice and assistance required to undertake research reactor programs. These agreements proved to be of considerable interest to the nations of the world and some 30 such arrangements are in effect at the present time.

B. The Overall Program of Research Reactor Assistance

Once the basic arrangements were entered into the United States undertook to provide foreign countries with an impressive amount of technical assistance of relevance to the use of research reactor facilities:

(a) Several hundred students were trained at facilities and in fields related to the operation and effective utilization of research reactor facilities. (The training offered at the Institute of Nuclear Science and Engineering and the Oak Ridge Reactor Supervisors School are good examples.)

(b) The United States established a special program in August, 1956 to provide foreign governments with advice and counsel on problems related to

reactor hazards evaluation (see Appendix A).

(c) A sizeable amount of unclassified information was disseminated to foreign countries in fields related to the use of such facilities.

(d) The versatility and usefulness of research reactors was demonstrated in various "Atoms for Peace" exhibits as well as at the Geneva Conferences of 1955 and 1958, and

(e) The United States expressed its willingness to provide materials for such facilities under increasingly attractive terms.*

In addition to these steps, two other contributions to foreign research reactor programs are worthy of special mention:

(f) First american industry demonstrated an impressive capacity and willingness to manufacture research and test reactors designed to satisfy the needs of the foreign program, and

(g) Starting in 1955, the United States undertook a program to provide foreign countries with financial assistance towards the acquisition of research reactor facilities.

The magnitude of the overall achievements to date may be deduced from the

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* (1) When the original agreements designed to assist research reactors were executed, they provided for the lease of up to six (6) kilograms of contained U-235 in uranium enriched up to a maximum of 20% U-235, plus such additional amounts as, in the opinion of the Commission, were required to permit the efficient and continuous operation of the reactors while fuel elements were cooling or in transit. In addition, in recognition of the fact that high flux reactors required highly enriched fuel, starting in 1956, the Commission approved a policy permitting the transfer of U-235 of up to 90% enrichment for use on a materials testing reactor capable of operating with a core loading of up to eight (8) kilograms. (Transfers of this kind were to take place pursuant to agreements for cooperation containing comprehensive controls and safeguards.)

fact that, as of December 31, United States manufacturers had built or were building 38 research reactors for foreign countries. Of these, 20 already were in operation. A list of the research reactor facilities that have or are expecting to be exported is attached as Appendix B. In addition, and through various means, the United States was providing important assistance to research reactor facilities that either were built in the host country or manufactured outside the United States.

As of January 31, 1960, 295 kilograms of U-235 had been transferred to other countries by the United States for use in their research and test reactors.**

C. The Grant Program for Research Reactors

The United States' foreign research reactor grant program has been of particular value in stimulating the development of research reactor facilities overseas. This program derives from an offer made by President Eisenhower in

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** 235 kgs. for research reactors; 60 kgs. for test reactors.

* (1) continued:

As the program developed it became apparent that in the case of certain research reactors (as in the case of materials testing reactors) there were certain technical or economical advantages in the use of fuel enriched above 20 per cent with U-235. Accordingly, on April 25, 1958, the Commission announced a policy under which it would consider requests for highly enriched fuel for both research and materials testing reactors when such fuel had an economical or technical advantage over uranium containing 20% or less of U-235. Under this policy, fuel can be made available for reactors using up to eight (8) kilograms per core loading, plus additional fuel for pipeline, burn-up, and inventory purposes. As in the case of materials testing reactors, enriched uranium for research reactors only can be transferred pursuant to agreements with comprehensive safeguards. In the summer of 1959 this policy was further liberalized to apply to reactor experiments.

(2) Prior to 1958, it had been the Commission's general policy to transfer heavy water to foreign countries on a sale basis. However, on August 15, 1958, the Commission announced that it would permit the lease of heavy water for use in domestic or foreign research, medical or testing reactors to help reduce the cost of such projects and encourage the use and development of heavy water reactors. The policy also was designed to make more funds available for research and development to advance the peaceful applications of nuclear energy here and abroad.

the course of an address at Pennsylvania State University on June 11, 1955. The President stated, at that time, that the United States was prepared to contribute half the cost of research reactors undertaken by free nations capable of using them effectively "for the acquisition of the skills and understanding essential to peaceful atomic progress."

A program of grants to give effect to the President's offer was subsequently developed by the Atomic Energy Commission, and to date nineteen (19) grants have been approved. Funds for the grants have been budgeted in the "Atoms for Peace" section of the Mutual Security Appropriation. In four cases the reactors have been completed and are operating. The rest are under construction.

Each of the nineteen grant reactors is proving to be a major stimulus to the peaceful nuclear program of the country in which it is located, and collectively the reactors represent a significant portion of the activities carried on pursuant to the Agreements for Cooperation in the Peaceful Uses of Atomic Energy. A list of the research reactor grants which have been made is contained in Appendix "C".

Following are the principal terms and conditions of the foreign research reactor grant program:

1. The United States' offer is limited to one grant per country, and to $350,000 or half the cost of the total project, whichever is less, per grant.
2. The estimated costs with respect to which the amount of the U. S. contribution is fixed are not limited to the costs of the reactor itself, but may include the costs of housing the reactor, furnishing necessary utility facilities, and experimental and other equipment directly related to operation and use of the reactor.

3. The grants have been only to nations which have entered into Agreements for Cooperation with the United States.

4. In early 1958 it was agreed that grants would thereafter be restricted to cases in which the:

   a. construction of the reactor would be performed by an American firm or an organization within the applicant country (or a combination of both); and

   b. major components of the reactor, such as the fuel elements, core structure, reactor bridge, pressure vessel, control system and cooling system, would be manufactured by American firms or organizations within the applicant country.

5. Beginning in December 1958, grants also were restricted to countries where a clear need exists for economic assistance.

6. While a grant may be approved prior to commencement of construction, the funds are actually paid to the recipient government only upon completion of the project and successful conclusion of initial operating tests. Prior to approval of a grant, the applicant government is required to certify that it has available and is prepared to expend sufficient funds to complete and operate the project.

7. A government wishing to apply for a grant is asked to submit a comprehensive proposal describing the project in detail, stating plans for recruiting or training technical personnel necessary to operate and utilize the reactor, and outlining the experimental and training programs to be carried out. Particular attention is given to the question of whether the reactor promises to be effectively used and operated. The proposal is reviewed by the AEC and if found satisfactory becomes the basis for approval of a grant. Approval is, in each case, coordinated with the Department of State.

8. The approval of a grant does not imply any assumption of responsibility by the United States for the safe operation of the reactor or any assurance that the United States approves of the technical details of the project. A detailed circular outlining the conditions of the grant may be found in Appendix "D." As noted above, the United States also offers advisory assistance in reactor hazard evaluation to any nation contemplating construction of a reactor under the terms of an Agreement for Cooperation with the United States. (See Appendix "A".)

In addition to assisting the recipient countries, the grants have been of value to industry at home and overseas. Because of the relative strength of the industrial capacity within the United States to manufacture such facilities, the preponderant number of the grants (17) have been applied to reactors of U. S. design and manufacture.

The Belgian Materials Testing Reactor (BR-2) was built by Belgian contractors, with an American firm acting as consulting engineer. The fuel elements were fabricated, and certain of the components also were furnished, by American firms. A significant training program in support of this facility was undertaken by the contractors.

The Norwegian research reactor for which a grant has been approved, is being constructed by the Norwegian Atomic Energy Institute. The Norwegians plan to purchase about $300,000 worth of heavy water from the United States, and to obtain certain control equipment in this country.

Because most nations that can take advantage of this assistance have done so, plans have been completed for the orderly termination of the reactor grant program. Under this plan, reactor grant proposals must be received by the AEC prior to July 1, 1960, to be eligible for consideration. Such proposals need not, however, be complete, and may be supplemented within a reasonable time thereafter with the additional information necessary.

Requests received after June 30, 1960, will be considered on a competitive basis with all other aid proposals for the particular country concerned and any U. S. funds granted would derive from regular country program funds of the Mutual Security Appropriation.

As the projects receiving grants come into operation, particular attention will be paid to following the development of the research and training programs associated with the facilities to assure they will be effectively utilized. Technical representatives and members of the Commission staff or contractor organizations generally visit most of the foreign nuclear facilities periodically and have the opportunity to observe the progress of the work.

The USAEC Scientific Representatives stationed in various parts of the world also are almost constantly engaged in providing advice and

counsel to the countries to whom they are accredited and are encouraged to identify ways in which the United States can contribute to the efficiency and success of foreign programs.

The four "grant" reactors which have come into operation are:

1. The 5MW pool-type reactor at Sao Paulo, Brazil;
2. The 3MW pool-type reactor at Madrid, Spain;
3. The 5MW tank-type reactor at Ispra, Italy;
4. The 1MW pool-type reactor at Munich, Germany.

A brief report on their current status is attached as Appendix E. There is every evidence that these four facilities will figure prominently in their respective programs and will be effectively utilized. Inasmuch as the reactors are in an initial stage of operation, the principal emphasis to date has been on testing the reactors and obtaining a precise indication of their operating characteristics.

D. The Equipment Grant Program

Beginning in FY 1958, funds from the "Atoms for Peace" section of the Mutual Security Program have been utilized also for grants for equipment (other than research reactors) for nuclear training and research. It has thus been possible to strengthen in other important respects the nuclear programs of nations having or acquiring reactors, and to contribute significantly to the programs of nations not prepared to acquire reactors. A list of the grants which have been made, as well as their intended use, is contained in Appendix "F."

Training and research equipment provided under this program contributes to the recipient nations' ability to undertake research and training in fields related to the peaceful uses of atomic energy and also enables them to train their own scientific personnel.

The equipment contributes to the effectiveness of other United States' programs for training foreign nationals in this country and for assisting foreign countries in the acquisition of research reactors. Often the equipment makes possible those applications of atomic energy in which tangible benefits are most immediate—agricultural and medical applications in particular.

In general, the equipment to be provided has been so selected as to constitute largely self-sufficient units, frequently referred to as "package laboratories," tailored to the conditions and program objectives of the respective recipient institutions. The program is highly flexible, and assistance may be given appropriate to a wide variety of situations. The

grants have been made on a government-to-government basis, for governmental laboratories or non-profit institutions. The recipient government or institution has been expected to procure the equipment in accordance with previously approved specifications, whereupon reimbursement (up to previously agreed maxima) is made by the United States. The recipient nation or institution undertakes to house and maintain the equipment, and to meet the cost of transporting it to its destination.

In December 1959, a general policy was adopted of restricting grants for equipment to those countries having a clear economic need for them.

Approval of a grant is in each case coordinated with the Department of State. The types of laboratories most frequently granted are:

1. General radioisotope laboratory

   This laboratory includes equipment used for the handling, detection and measurement of radioactive material in the broad spectrum of applications of radioisotopes to miscellaneous problems. Groupings of equipment in this category have most frequently been requested for the purpose of initiating or reinforcing training projects.

2. Medical radioisotope research and training laboratory

   This laboratory, in general, includes equipment similar to that in the "general radioisotope laboratory" but selected partially for application in the medical sciences.

3. Nuclear engineering laboratory

   The major item in this set of equipment is a subcritical facility for use primarily as an instructional laboratory for experiments in reactor theory and neutron physics. As in this country, the subcritical has been a popular tool around which to build the laboratory phase of a nuclear engineering training program.

4. Co-60 teletherapy laboratory

This facility consists essentially of a Co-60 teletherapy unit for the treatment of cancer patients and for training of medical personnel.

5. Co-60 agricultural irradiator facility

The principal piece of equipment is a device using a Cobalt-60 source to irradiate growing plants to study radiation-induced mutations.

In addition to grants administered by the AEC, equipment has been provided by the International Cooperation Administration in certain instances.

It should be noted that, in his address to the Third General Conference of the International Atomic Energy Agency in September 1959, Commissioner John F. Floberg expressed the United States' recommendation that the IAEA begin to plan for "an enlarged technical assistance program that will include the offering of equipment to members of the Agency," and pledged the support of this country to such an effort. While, at least for the present, the United States expects to maintain a program of bilateral assistance in acquisition of nuclear equipment, it expects the IAEA might participate increasingly in equipment assistance in the future.

D. Conclusion

Both the reactor and equipment grant programs have met with strong response and are clearly contributing substantially to fulfillment of the objective expressed by the President at Pennsylvania State University, of assisting free nations in "the acquisition of the skills and understanding essential to peaceful atomic progress." At this time, when most of the reactors are still under construction, the results are only beginning to be apparent; they will develop

increasingly in the next several years and continue indefinitely thereafter. Some of the benefits will return to the U. S. as a result of the expanded programs carried on with the grant reactors and equipment, and of work done by scientists to whose training one of the reactors or grant laboratories has contributed.

The reactor and equipment grant programs have done a great deal to stimulate sound planning and the development of suitable nuclear energy organizations in the participating states. In the process of developing acceptable proposals a number of the countries have been prompted to identify the steps they would have to take to place their emerging program on a sound and efficient basis.

APPENDIX "A"

UNITED STATES
ATOMIC ENERGY COMMISSION
Washington 25, D. C.

UNITED STATES ASSISTANCE TO COOPERATING COUNTRIES IN REACTOR HAZARD EVALUATION

I. Nature of Assistance Available from the U. S. Atomic Energy Commission.

The U. S. Atomic Energy Commission is prepared to render assistance in reactor hazard evaluation to any nation contemplating construction of a reactor under the terms of an Agreement for Cooperation with the United States. The Atomic Energy Commission does not certify or approve the safety features of reactors constructed abroad, considering such decisions to be part of the responsibility assumed by each nation undertaking to construct and operate a reactor. The AEC will, however, provide detailed information on the methods it employs in hazard evaluation of reactors designed, constructed and operated in the United States.

Upon request of a cooperating country, AEC will hold discussions on reactor hazards with its representatives, and, if appropriate, with representatives of a contractor to a cooperating country. A primary objective of such discussions is to explain in detail to the cooperating country the methods by which decisions are reached in the United States as to the feasibility of constructing and operating reactors at proposed locations without undue risk to public safety.

The AEC bases such decisions on reactors to be located in the United States upon a "hazard summary report," which cooperating countries are urged to prepare upon their own proposed reactors. At the time of any discussions on hazards between representatives of a cooperating country and AEC it is helpful to have available full information on the principal points which are covered in hazard summary reports in the United States, in order that features of the proposed reactor can be considered specifically in discussing safety analysis.

Discussions of reactor hazards between cooperating countries and the AEC are arranged by AEC's Division of International Affairs. The AEC's Division of Civilian Application participates in such discussions to provide technical information and advice.

In considering applications for U. S. financial assistance on foreign research reactor projects under the terms of President Eisenhower's offer of June 11, 1955, the AEC does not consider it appropriate or practical to require completion of a hazard summary report prior to commitment of U. S. funds. However, AEC does ask for preliminary information at this time, to assure itself that hazards problems are recognized and that appropriate plans exist for dealing with them.

II. Scope of Hazard Summary Reports on Proposed Reactors in the U. S.

In the domestic program, the AEC requires that the following information be given in a hazard summary report on a reactor to be located in the U. S.:

(a) A description of the chemical, physical, metallurgical, and nuclear processes to be performed, and a statement of the kind and quantity of any radioactive effluent expected to result from the processes. The description of the processes should be sufficiently detailed to permit evaluation of the radioactive hazards involved. The magnitude of the proposed operation should be indicated in the terms of the amount and radioactivity of source, special nuclear, or by-product material to be handled per unit of time, and thermal power to be generated if any.

(b) A description of the site on which the facility is to be located. This should include a map of the area showing the location of the site and indicating the use to which the surrounding land is put, i.e., industrial, commercial, agricultural, residential; location of source of potable or industrial water supply, watershed areas and public utilities; a scale plot plan of the site showing the proposed location of the facility; and population densities as a function of distance and direction from the site.

(c) Meteorological, hydrological, geological, and seismological data necessary for evaluating the measures proposed for protecting the public against possible radioactive hazards.

(d) A description of the facility. The description should be based on the design criteria for the facility as a whole and for those major component parts which are essential to the safe operation of the facility, and should be presented in sufficient detail to allow an evaluation of the adequacy of the various means to minimize the probability of danger from radioactivity to persons both on and off-site. The description should also cover any activities proposed to be carried on in the building which will house the facility and on the balance of the site.

(e) A description of proposed procedures for: routine and non-routine operations, start-up and shut-down, maintenance, storage, training of employees, minimizing operation mishaps (such as locked controls, check-lists, and close supervision), investigating unusual or unexpected incidents; and a description of such other details as may be useful in evaluating the existence and effectiveness of safeguards against the radioactive hazards in the operation of the facility.

(f) An evaluation of the proposed measures and devices to prevent acts or accidents which would create radioactive hazards or to protect against the consequences should acts or accidents occur, including detailed design and evaluation of containment structures.

(g) A description of emergency actions including evacuation plans in the event of sudden release of radioactivity which might result in dosages in excess of tolerance. The description should relate the various operational procedures, the protective devices, and the pertinent features of the site, to such happenings as operational mistakes, equipment or instrument failure or malfunction, fire, electric power failure, flood, earthquake, storm, strike, and riot.

(h) A description of procedures for disposal of radioactive solid waste and final disposal of liquid waste effluent.

(i) A description of procedures provided to sample atmosphere discharges through stacks where such stacks may emit by-product material or special nuclear material.

(j) Analyses of accidents remotely conceivable despite all planned safeguards, which would endanger life and property both on and off-site.

UNITED STATES ATOMIC ENERGY COMMISSION
DIVISION OF INTERNATIONAL AFFAIRS
Washington 25, D. C.

August 23, 1956

APPENDIX "A"
ENCLOSURE 'A'

MINIMUM POINTS TO BE COVERED IN
FOREIGN RESEARCH REACTOR PROPOSALS

1. A description of the reactor, to include:

   a. conceptual design of the reactor and important auxiliary equipment;

   b. expected operating levels--maximum power, excess reactivity and reactivity analysis;

   c. fuel, moderator, coolant, reflector and shielding;

   d. reactor control system,

   e. experimental irradiation facilities--thimbles, beam holes, etc.

2. A description of the reactor building, including contemplated floor plan and elevation drawings. (If the building is to provide for containment of radioactive vapor, the estimated maximum internal pressure for which it will be designed should be approximated.)

3. A desciption of all the facilities, including research facilities, related directly to operation and utilization of the reactor.

4. Indication of the principal organizations with which contracts will be entered into in connection with construction of the projects, including the organization which will fabricate fuel elements.

5. A detailed breakdown of the estimated cost of facilities towards which the United States' financial contribution would be applied, including building, reactor, utility and other directly related auxiliary services. (When practicable, supporting bids should be provided.)

6. A schedule for construction and completion of the project, indicating dates fuel material will be required, start-up of reactor, etc.

7. A description of the organization planned to operate and utilize the facility, with indication of the training and qualifications of the principal personnel who will be responsible for the effective and safe operation of the facility. In particular, plans should be stated for fixing responsibility for performing and evaluating the hazard analysis of the reactor, and for supervision and approval of experimental procedures subsequent to the initial operation of the reactor.

54953 O—60—vol. 2——19

8. A description of any plans to accomplish technical training deemed necessary to effective utilization of the reactor, if availability of qualified technical personnel cannot be assumed; a statement of how any such measures will be financed. Any plans for utilizing technical personnel of qualified commercial firms during design, construction, start-up and early operation, should be included.

9. An estimate of fuel requirements for the initial five years, i.e., total inventory requirements, burn-up, reprocessing and recharging rates, etc.

10. At least preliminary information on hazards and hazards control. This should include: description of the site, with maps showing the location or alternative locations of the reactor; data on population density as a function of distance and direction from the site, and the location of nearby buildings and residential areas; environmental data, including the general meteorology, geology, hydrology and seismology of the area; contemplated restrictions on power level and excess reactivity; a general description of operating procedures and protective devices to function in event of operational errors, instrument malfunction, electric power failure or failure of the reactor cooling system; and provision for disposal of normal gaseous, liquid and solid wastes, and of such waste materials accidentally released from the reactor. (It is expected that much of this information will be general and preliminary and that the cooperating country will ordinarily complete a comprehensive hazard summary report at a later time.)

11. A brief characterization of the proposed technical program for utilization of the reactor, including types of experiments to be performed.

APPENDIX "A"
ENCLOSURE 'B'

REPRESENTATIVE ITEMS WHICH MAY BE CONSIDERED AS INCLUDED WITHIN THE TERM "REACTOR PROJECT" IN COMPUTING THE COST ESTIMATE WITH RESPECT TO WHICH THE AMOUNT OF THE U. S. CONTRIBUTION WILL BE SET

A. Reactor.

1. Fuel. Only fabrication costs of the initial fuel elements may be included.

2. Moderator and Reflector. The moderator and reflector in quantity and form ready for insertion in the reactor.

3. Core Structure. The structure containing and providing support for the fuel and moderator. (May also contain the reflector and thermal shield.)

4. Shield. Shielding as required to reduce radiation levels to tolerance dosages for personnel and equipment.

5. Cooling System. As required, may include heat exchangers, pumps and drives, piping, valves, pressure temperature and flow instrumentation, equipment for coolant, purity control and make-up.

6. Controls and Instrumentation. A complete control system for the operation of the reactor. This system will provide for normal operation of the reactor at a specified level and incorporate a number of safety features such as automatic alarms, power setbacks and reactor shutdown. It is intended to include (1) the basic sensing elements of the control system (fission and gamma chamber, thermocouples, pressure gages, flow meters, etc.), (2) the electronic and electromechanical equipment required to translate signals received from the sensing elements into motion (amplifiers, solenoid release circuits, etc.), (3) the control elements (neutron absorbing regulating and safety rods and their drives), and (4) a control console (operator's desk with key control buttons and switches and a bank of recording and indicating instruments.)

7. Miscellaneous Equipment Directly Related to the Reactor.

Equipment as needed for normal operation of the reactor, including: special handling tools to be used in loading and unloading fuel, including transfer and shipping coffins, health physics instruments, off gas disposal equipment, sampling systems, etc.

8. Design, Installation and Start-up. In addition to the detailed design, procurement and fabrication of the components listed above, installation of these components, start-up and initial operation and testing of the plant.

B. Facilities Directly Related to the Reactor.

1. Building and Ancillary Facilities. Cost of design and construction of the building or buildings, including foundation, superstructure, overhead crane, utilities, heating and ventilation, laboratory shops and office space, site improvement and utility connections.

2. Experimental Equipment. Initial equipment to be used in conjunction with experiments utilizing the reactor or its products.

3. Disposal System. Disposal system for solid and liquid radioactive wastes.

C. Services Directly Related to the Reactor.

1. Consultants. Payment of qualified consultants to assist in selection of the reactor, and planning for construction and operation of the reactor project.

2. Training. On-site training of operating personnnel for the reactor, prior to and during start-up.

APPENDIX "B"

U. S. REACTORS FOR EXPORT

Research, training, and testing

Owner	Location	Principal Contractor	Type	Thermal Power (Kilowatts)	Start-up
Operable:					
Belgium Congo, Gov't of (Univ. of Lovanium)	Leopoldville	GEC	TRIGA	10	1959
Brazil, Gov't of (Univ. of Sao Paulo)	Sao Paulo	BAW	Pool	5,000	1957
Canada, (McMaster University)	Hamilton, Ont.	AMF	Pool	1,000	1959
Denmark, Gov't.of (Atomic Energy Commission)	✓Risoe	AI	L-55	Negligible	1957
Denmark, Gov't. of (Atomic Energy Commission	✓Risoe	PW	Tank	5,000	1958
Germany, Fed. Rep. of (Munich Tech. Univ.)	Munich	AMF	Pool	1,000	1957
Germany, Fed. Rep. of (University of Frankfurt)	Frankfurt	AI	L-54	50	1958
Germany, (Interatom, Inc.)	Duisberg	AI	L-77	Negligible	1958
Germany, Fed. Rep. of (Society for the Utilization of Nuclear Energy in Shipbuilding & Navigation, Inc.)	Geesthacht	BAW	Pool	5,000	1958
Italy, Gov't of (National Committee for Nuclear Research)	✓Ispra	AC	Energy-water tank.	5,000	1959
Italy (ENRIN Nuclear Center)	Chivasso	AMF	Pool	5,000	1959
Italy (Milan Polytechnic Institute)	Milan	AI	L-54	50	1959
Italy (University of Palermo)	Palermo	ACM	201-110	Negligible	1960
Japan, Gov't of (Atomic Energy Research Inst.)	Tokai-mura	AI	L-54	50	1957
Netherlands, Gov't of (Delft Tech. Univ.)	Delft	AMF	Pool	100	1957
Spain, Gov't of (Nuclear Energy Board)	✓Madrid	GE	Pool	3,000	1958
Switzerland, Gov't of (Reactor Inc.)	✓Wuerenlingen	ORNL	Pool	1,000	1957
Switzerland (University of Geneva)	Geneva	ACM	201-111	Negligible	1958
Switzerland (University of Basel)	Basel	ACM	Z11-100	Negligible	1958
West Berlin, City of (Hahn-Meitner Inst. for Nuclear Research)	West Berlin	AI	L-54	50	1958
Being Built:					
Austria, (Gov't of (Ministry of Education))	Near Vienna	GEC	TRIGA	30	1960
Austria, Gov't of (Seibersdorf Research Center)	Seibersdorf	AMF	Pool	5,000	1960
Brazil (University of Minas Gerais)	Belo Horizonte	GEC	TRIGA	30	1960

(continued)

U. S. REACTORS FOR EXPORT

Research, training and testing (cont'd)

Owner	Location	Principal Contractor	Type	Thermal Power (Kilowatts)	Start-up
Being Built - continued:					
China, Republic of (National Tsing-Hua Univ.)	Hsinchu	GE	Pool	1,000	1960
Greece, Gov't of (Atomic Energy Commission)	Athens	AMF	Pool	1,000	1960
Iran, Gov't of (University of Tehran)	Tehran	AMF	Pool	5,000	1961
Israel, Gov't of (Atomic Energy Commission)	Tel-Aviv	AMF	Pool	1,000	1960
Italy, Gov't of (National Committee for Nuclear Research)	Rome	GDC	TRIGA-Mark II	100	1960
Japan, Gov't of (Atomic Energy Research Inst.)	Tokai-mura	AMF	Heavy-water	10,000	1960
Japan (Kinki University)	Osaka	AS	-	Negligible	1960
Netherlands, Gov't of (Reactor Center)	Petten	AC	Tank (MTR)	20,000	1961
Philippines, Gov't of (National Science Development Board)	Quezon City	GE	Pool	1,000	1961
Portugal, Gov't of (Nuclear Energy Board)	Lisbon	AMF	Pool	1,000	1960
Sweden, Gov't of (Atomic Energy Company)	Studsvik	AC	Tank(MTR)	30,000	1960
Thailand (Chulalongkorn University)	Bangkok	CW	Pool	1,000	1961
Turkey, Gov't of (Atomic Energy Commission)	Istanbul	AMF	Pool	1,000	1960
Venezuela, Gov't of (Inst. of Neurology and Brain Research)	Caracas	GE	Pool	3,000	1960
Viet-Nam, Gov't of	Dalat	GDC	TRIGA-Mark II	100	1961
Planned:					
Finland, Gov't of (Institute of Technology)	Helsinki	GDC	TRIGA-Mark II		
Germany (University of Mainz)	Mainz	GDC	TRIGA-Mark II	100	
Italy, Gov't of (C.A.M.E.N.)	Laverno	B&W	Pool	5,000	1960
Japan (Rikkyo University)	Yokosuka City	GDC	TRIGA-Mark II	100	1961
Japan (Nagaoki Inst. of Technology)	Kawasaki City	GDC	TRIGA-Mark II	100	
Korea, Gov't of (Atomic Energy Commission)	Seoul	GDC	TRIGA-Mark II	100	1960
Pakistan, Gov't of (Atomic Energy Commission)	Dacca	AMF	Pool	1,000	

Pakistan, Gov't of (Atomic Energy Commission)	Tarila	AMF	Pool	1,000	

APPENDIX "C"

RESEARCH REACTOR GRANTS PAID, OBLIGATED, OR PENDING
F. Y. 1956--1959
(Listed by date of obligation)

COUNTRY	SITE LOCATION	TYPE	POWER (HEAT)	TOTAL PROJECT COSTS (EST.)	DATE OF OBLIGATION*
Brazil**	Sao Paulo	Pool	5 Mw	$1,300,000	May 22, 1956
Spain**	Madrid	Pool	3 Mw	999,969	May 30, 1956
Netherlands	Petten	Tank	20 Mw	3,879,674	June 29, 1956
Denmark	Riso	Tank	5 Mw	1,395,500	June 29, 1956
Japan	Tokai-mura	Tank	10 Mw	1,500,000	June 28, 1957
Portugal	Lisbon	Pool	1 Mw	951,000	June 28, 1957
Venezuela	Caracas	Pool	3 Mw	5,060,000	June 28, 1957
Italy**	Ispra	Tank	5 Mw	3,553,350	February 3, 1958
Greece	Aghia Paraskevi	Pool	1 Mw	1,273,000	February 11, 1958
Sweden	Studesvik	Tank	30 Mw	4,291,995	April 28, 1958
Israel	Rehoveth	Pool	1 Mw	1,410,000	May 2, 1958
W. Germany**	Munich	Pool	1 Mw	3,066,086	May 27, 1958
Belgium	Mol	Tank	25 Mw	10,000,000	May 27, 1958
China	Hsinchu	Pool	1 Mw	930,500	May 28, 1958

* Date on which U. S. commitment was made.

COUNTRY	SITE LOCATION	TYPE	POWER (HEAT)	TOTAL PROJECT COSTS (EST.)	DATE OF OBLIGATION
Norway	Kjeller	Pool	10 Mw	$ 778,000	July 10, 1958
Korea	Anyang	TRIGA II	100 Mw	1,043,000	January 2, 1958
Thailand	Bangkok	Pool	1 Mw	1,122,000	June 24, 1959
Viet-Nam	Dalat	TRIGA II	100 Mw	974,000	June 29, 1959

KEY

1/ Went critical

2/ CEN - Centre d'Etudes de l'Energie Nucleaire
Ben - Bureau d'Etudes Nucleares
NDA - Nuclear Development Corporation of America

3/ Noratom - Norwegian Institute for Atomic Energy

** Grant paid

APPENDIX "D"
UNITED STATES
ATOMIC ENERGY COMMISSION

Washington 25, D. C.

INFORMATION FOR NATIONS DESIRING U. S. FINANCIAL ASSISTANCE ON RESEARCH REACTOR PROJECTS

The U. S. Atomic Energy Commission has been given responsibility for implementing the United States' offer announced by President Eisenhower on June 11, 1955, to contribute towards the cost of research reactors undertaken by "free nations who can use them effectively for the acquisition of the skills and understanding essential to peaceful atomic progress." Contributions made pursuant to the President's offer are financed from funds made available under the Mutual Security Act of 1956.

A prerequisite to a financial contribution by the United States towards the cost of a research reactor project undertaken by a foreign nation, is an Agreement for Cooperation in the Civil Uses of Atomic Energy between that nation and the United States. Such agreements are negotiated for the United States jointly by the Department of State and the Atomic Energy Commission.

Under an Agreement for Cooperation in the Civil Uses of Atomic Energy, the cooperating nation receives information on the design, construction and operation of research reactors and their use as research, development and engineering tools. In addition, each agreement provides a basis for authorizing private citizens and organizations in the United States to supply the cooperating government or authorized private persons under its jurisdiction, with appropriate equipment and services. Each agreement provides that the U. S. Atomic Energy Commission will furnish a specified quantity of uranium enriched in the isotope U-235. The cooperating nation assumes responsibility for using and safeguarding the fissionable material in accordance with the terms of the agreement. Each agreement further provides for the exchange of information in the research reactor field, on related health and safety problems and on the use of radioactive isotopes in physical and biological research, medical therapy, agriculture and industry.

Having entered into an Agreement for Cooperation, a nation desiring U. S. participation in financing a research reactor project should submit a project proposal to the Director, Division of International Affairs, U. S. Atomic Energy Commission, Washington 25, D. C. The project proposal should include at a minimum, information on the points listed in the enclosed "Minimum Points to be Covered in Foreign Research Reactor Proposals" (Enclosure 'A'). For purposes of expediting review, it is desirable that five copies of the proposal be submitted. Interested nations should submit their proposals when they have firm plans for the scope and nature of the project, and have tentatively selected a bid for construction of a

3/ NoRaTom - Norwegian Institute for Atomic Energy
** Grant paid

specific reactor. The project proposal should be accompanied by a letter from the interested country, stating its desire to take advantage of the President's offer of financial assistance. It is not necessary that a contract for construction of a reactor be signed by a cooperating country prior to receipt of formal assurance of availability of U.S. funds.

The amount of the U. S. financial contribution may be set with respect to the cost not merely of a reactor per se, but of a reactor with such experimental equipment and supporting facilities and activities as are necessary to make it an operable and useful training and research tool. The U. S. grant thus envisages a "reactor project"; Enclosure 'B' lists representative items which may be considered as included within the term "reactor project", in computing the cost estimates with respect to which the amount of the U. S. contributions will be set.

A limitation of $350,000 has been set upon the amount of the U. S. contribution to any cooperating country under the program for implementing the President's offer; this amount is 50% of the estimated cost of an assumed typical research reactor project. In the case of reactor projects estimated to cost less than $700,000, the amount of the U. S. contribution will be set at 50% of the estimated cost. It is also required that any contracts with U. S. firms provide that such portions of the equipment furnished by firms as may be appropriately die-stamped as a product of the United States, shall be so stamped.

The principal purpose of the review of the project proposal by the AEC is to confirm that the project qualifies for U. S. financial assistance under the President's offer, and that it conforms with the governing Agreement for Cooperation. In addition, the amount of the U. S. contribution is determined in the course of the review. The cooperating nation is considered as having complete responsibility for the project, and thus the review of the proposal by the AEC is not intended as a basis for extending United States concurrence in the technical details of the proposal. The review does seek to confirm that the principal problems inherent in the construction and operation of a reactor are recognized, including the problem of possible radiation hazard to the environment, and that there is reason to feel confidence that they will be competently dealt with. Essentially, the review seeks to establish that a proposed project gives the promise of promoting the skills and understanding essential to peaceful atomic progress, which is the main condition of qualification under the President's offer.

The AEC makes formal commitment as to the U. S. contribution when:

(a) a finding has been made based upon review of the project proposal, that the project qualifies for financial assistance under the President's offer, and that it conforms with the applicable Agreement for Cooperation, and

(b) formal assurance has been provided by the cooperating nation, that it has available and is prepared to expend sufficient funds for completion and subsequent operation of the reactor project.

The U. S. financial contribution will be made in the form of a grant, and paid to the cooperating nation in American dollars, upon receipt from the government of the cooperating country of a certification as to completion of the reactor project to the agreed scope, to be accompanied by a certification by the principal firm or firms which have contracted to render services in connection with the project, as to completion of such services. Such certifications as are rendered by U. S. firms shall also state that such portions of the equipment furnished by them as may be appropriately die-stamped as a product of the United States, have been so stamped.

In accordance with the terms of the governing Agreement for Cooperation, the U. S. Atomic Energy Commission is prepared to offer consultation and advice to a cooperating nation at any stage in its prosecution of a research reactor project.

United States Atomic Energy Commission
Division of International Affairs
Washington 25, D. C.

APPENDIX "E"

STATUS REPORT ON "GRANT" REACTORS IN OPERATION

ITALY

The Ispra reactor (Italy) was constructed by ACF Industries Incorporated. It is a 5 Mw, tank-type, heavy water cooled and moderated, heterogeneous, enriched uranium reactor.

The fuel elements, of which there are 37, are spaced in an open array in a four foot diameter aluminum tank containing heavy water. The tank, in turn, is surrounded by a two foot thick anular ring of graphite for use as a reflector. The graphite is surrounded by thermal and biological shields. These are pierced by numerous horizontal, vertical and subvertical experimental openings.

Status: The Ispra reactor went critical in March, 1959. Through October of 1959 extensive experimentation and testing was performed to determine and provide detailed information on the characteristics of the reactor. This included calibration of the control rods, measurement of void factors, determination of reactivity coefficients, and testing of instrumentation.

Initially the reactor was operated at zero or low power and flux measurements and the determination of the core configuration were performed. The reactor then went to its normal power rating following which the cooling equipment was tested and the temperature distribution in the core was determined. In addition, measurements have been performed of the gamma field on heating in various points in the reactor as well as the shielding.

To date the reactor has been operating on a core of 20% enrichment obtained from the United States. A second core of 90% enrichment is due to be inserted in the near future. Following the insertion of the new core the reactor will be operated at zero

power. Full power will be reached in April or May.

The Ispra reactor is expected to figure prominently in nuclear research programs of Italy and the European Atomic Energy Community. Pursuant to a currently anticipated agreement between the Italian Government and EURATOM approximately one-half of the reactor will be devoted to work sponsored by EURATOM and of interest to the entire Community.

Research programs now in progress or being set up are:

a. nuclear cross section measurements--a "fast chopper" is now being set up;

b. neutron spectroscopy experiments for work on crystal structure;

c. experiments on radiation damage to materials; and,

d. the irradiation of uranium metal alloys under high temperatures.

In addition plans are being made for rigging a high pressure, high temperature gas-loop, for producing radioisotopes for the internal use of the Ispra laboratory, for testing parts of equipment (the behaviour of thermo couples in a high irradiation field) and proposals have been made to the U. S.-EURATOM Joint Research and Development Board for the support of a program on the production and testing of Uo_2 fuel elements. In addition a rig is now being constructed for irradiating thorium oxide with the objective of developing irradiation techniques.

As will be noted emphasis during the last year has been devoted to the initial testing and start up of the reactor and in placing research experiments in place. Throughout this period a significant number of graduate and undergraduate students and visiting technical personnel were trained in, or permitted to observe, the various operations.

BRAZIL

The Brazilian Research Reactor, located at the University of Sao Paulo, Sao Paulo, Brazil, is a 5 megawatt swimming pool-type research reactor with associated cooling, beam ports, thermal column, pneumatic system, and special fuel-handling equipment. It was built by Babcock and Wilcox.

The initial fuel loading of 5,867 Kgs of U-235 in uranium enriched to 20% was transferred to Brazil in August, 1957 and the reactor went critical in September, 1957. The reactor check-out and indoctrination phase was complicated and prolonged because of fuel element failure due to corrosion. This difficulty has now been overcome and during initial runs at low temperatures the critical mass of several lattices, water and graphite reflected, was determined. The reactivity of beam holes, empty and water-filled, and the effects of typical experiments charged at various positions have been studied. Temperature coefficients have been measured, rods and instruments calibrated and flux traverses made.

During the check-out period, the power level was raised gradually from the zero power of the initial nuclear experiments to the full design power level. An experimental program is now being conducted.

The Chemistry Division of the University is using one position in the grid plate for activation analyses involving short half-life materials. These experiments have included analyses of gold ore for gold content, zirconium ore for hafnium, and various materials for sodium content.

Irradiations have also been conducted on natural graphite found in Brazil to determine the degree of purity.

The Radiobiology Division has been formulating techniques and equipment for conducting studies, using radioisotopes from the reactor.

SPAIN

The Spanish research reactor, located near Madrid, is a 3 megawatt, pool-type, light-water moderated and cooled reactor suspended from the bridge structure in either of two pool sections.

The initial fuel loading was transferred on December 5, 1957, and consisted of 4.044 Kgs of U-235 in uranium enriched to 20%.

The reactor went into operation October 9, 1958, and was formally dedicated November 27, 1958.

Initially, the reactor was operated at about 100 kilowatts while completing check-out, indoctrination of personnel, and the formulation of operational procedures.

The experimental program for the utilization of the reactor includes the following categories:

a. development of reactor

b. acquiring operating and nuclear experience, and

c. research in the field of radiation.

In carrying out this program, the reactor is used for the separation of radioisotopes for, among others, the Instituto Nacional del Cancer and the Instituto Rocardara, the two principal users in Spain.

In using the reactor as a tool in the development of reactor technology, it is used for training nuclear scientists and will later be used to test components intended for other reactors.

Typical experiments include measurement of slow neutron cross-sections; experimental verification of natural uranium-graphite lattices; and shielding experiments to obtain the efficiency with which various materials attenuate neutron and gamma radiation.

A study of radiation effects is planned. This will include the biological effects of neutrons as a function of dose and dose rate, radiation effects on organic polymer and crystalline solids, and chemical analysis by neutron activation.

WEST GERMANY

The West German research reactor is a 1 megawatt, heterogeneous, light-water moderated and cooled, swimming pool-type, initially fueled with slightly over 4 Kgs of U-235 in uranium enriched to 20%. The reactor was constructed by AMF Atomics, Inc., for the Technical University of Munich and is located at Garchinger Heide about 8 miles from the University.

The fuel elements were manufactured by Babcock and Wilcox, and were checked, cleaned, and alodized by Degussa, a large German rare metals firm, before being inserted in the reactor.

The reactor became critical in October, 1957. It was initially operated at low power (under 100 kilowatts) for training of personnel and for determination of the minimum critical mass. Subsequently, a series of critical studies was made to determine reactivity of various possible core loadings; the change of reactivity caused by experimental facilities and beam holes was investigated. Finally, a series of runs was made at low power to study the behavior of the reactor and to compile a detailed operational procedure.

The initial fuel transfer was made on August 29, 1957, and consisted of 5.927 Kgs of U-235 in uranium enriched to 50%. On July 17, 1958, seven fuel elements that had corroded were returned to the fabricators.

The Munich reactor is being utilized in an experimental program which includes three major areas:

1. Irradiation of elements and materials;
2. Experiments with neutron beams; and
3. Experiments at the reactor, both within and outside the pool.

The completed research includes:

a. flux and reactivity measurement with reactor and collimator tubes;
b. neutron temperature measurements;
c. determination of disintegration rate of paladium isotopes 109 and 111; and
d. measuring over-all active cross-sections for cadmium, samarium europium and gadolinium.

Research presently in progress and that planned for the future include research with neutron diffraction equipment, measurement of fast-fission product and short-life fission activities; research with slow neutrons and monochromatic neutrons; angular correlation with lithium 8, measuring S_2-energy per fission and irradiation of reactor core of very low temperatures.

54953 O—60—vol. 2——20

UNITED STATES ATOMIC ENERGY COMMISSION

APPENDIX F

EQUIPMENT GRANTS AWARDED TO DATE

(FY 1958)

Italy	Co-60 agriculture irradiation unit	The Co-60 agricultural irradiation unit is to be used by the Comitato Nazionale per le Richerche Nucleare (CNRN) for the genetic improvement of species and plants such as wheat, corn and other cereals	$ 5,500.00.
Uruguay	Biochemical laboratory	The University of the Republic of Uruguay will use the biochemical laboratory for research on the metabolism of purines	$ 36,039.00
	Medical diagnostic laboratory	The medical diagnostic laboratory will be useful in the study of the thyroid function and for treatment of homopatias and chemical diagnosis	
	Co-60 teletherapy laboratory	The Department of Radiotherapy will use the Co-60 teletherapy unit for the treatment of approximately 1,000 cases of cancer yearly	
Greece	Subcritical assembly	The subcritical assembly will be used chiefly in providing training for the staff of the Democritus Nuclear Center and for nuclear engineering students	$126,761.00

		chiefly in providing training for the staff of the Democritus Nuclear Center and for nuclear engineering students	
Greece cont'd.			
		It will be used also in the development of a health physics program	
		(FY 1959)	
Colombia	Medical radioisotope research and training laboratory	The medical radioisotope research and training laboratory will be used by the Institute of Cancerology for training an increased number of doctors and medical technicians. It will also enable improved care to be given to a greater number of patients	$ 51,523.00
	Co-60 teletherapy unit	The Co-60 teletherapy unit will be used in the treatment of cancer patients, of whom over 4,000 have received treatment since the founding of the Institute of Cancerology in 1935	
Peru	General radioisotope training laboratory	The National University of Engineering at Lima will use the general radioisotope laboratory for training nuclear science students	$ 58,511.00
	Medical radioisotope research and training laboratory	The medical radioisotope research and training laboratory will be used by the Institute de Enfermedades Neoplasicus for training in the biological sciences and for the diagnosis and treatment of disease	
Argentina	Co-60 teletherapy unit	The Rivadavia Hospital proposes to use the teletherapy unit in the treatment of a case load of over 300 cancer patients a year	$ 65,771.00
	Medical radioisotope research and training laboratory	The medical radioisotope laboratory will be used for research and training purposes	

Argentina cont'd.			
		by the faculty and students of the Medical School of the University of Buenos Aires	
	Co-60 agricultural irradiation facility	The Co-60 agricultural irradiation facility will be used by the Instituto de Fitotecnica at Castelar for research in plant breeding and for performance of basic research for other agricultural stations in Argentina	$ 5, 640.00
Chile	General radioisotope laboratory	The general radioisotopes training laboratory will be used in training students of the Nuclear Physics Laboratory of the University of Chile in the applications of radioisotopes for medical, agricultural industrial uses	$ 57,852.90
	Medical radioisotope research and training laboratory	The Catholic University of Chile will use the medical radioisotope laboratory as a diagnostic tool, for therapy and for training purposes. It will be used also for research programs in biological and medical science	
Guatemala	Medical research and clinical radioisotope	The Roosevelt Hospital will utilize the medical research and clinical radioisotope laboratory for the diagnosis and treatment of disease; for research; and for training of medical students and specilists	$ 45,174.00
	Laboratory and Co-60 teletherapy laboratory	The Co-60 teletherapy unit will be used by the Guatemalan Cancer Institute to	

	Laboratory and Co-60 teletherapy laboratory	The Co-60 teletherapy unit will be used by the Guatemalan Cancer Institute to provide facilities for the treatment of cancer patients for Guatemala and nearby countries	
Guatemala cont'd.			
China	General radioisotope equipment and items of equipment for a nuclear engineering laboratory	The Institute of Nuclear Science of Tsing Hua University will use the general radioisotope equipment for training activities in radio-chemistry, radiation chemistry and the biological sciences. The nuclear engineering laboratory equipment will be used as a laboratory training tool for the courses in nuclear physics and engineering	$ 97,521.00
		The ultimate objective of the program is to increase agricultural and industrial productivity and to improve the methods of diagnosing and treating disease	
Ireland	General radioisotope training laboratory	The general radioisotope training and research laboratory will be used by the University College, Dublin, to give improved training in Nucleonics, the properties of nuclear radiation and radioactive substances for use in agriculture, science, engineering and medicine	$249,251.70
	General radioisotope training and research equipment and a subcritical assembly (including source material)	University College, Cork, will use the general radioisotope equipment and the subcritical assembly in training undergraduate students in nuclear engineering and physics	
	General radioisotope training research laboratory. Two Cesium-137 irradiation facilities	Trinity College of the University of Dublin will use the general radioisotope laboratory and the two Ce-137	$ 66,973.00

Ireland cont'd.			
		irradiation facilities for training of graduate and undergraduate students and for research in biochemistry, geology, physics, physiology and zoology	
Lebanon	Low-temperature research equipment, general equipment	The Department of Physics of the American University of Beirut will use the low -temperature research and the general radioisotope equipment in an expanded program of research and training in radioisotopes, nuclear physics and nuclear chemistry	$160,760.00
	Co-60 teletherapy facility	The Medical Facility of the American University will utilize the Co-60 teletherapy unit for treatment of patients and for training of specialists in its use	
New Zealand	Radioisotope Laboratory, a multichannel analyzer,	The University of Auckland will use the radioisotope laboratory and the multichannel analyzer for research and training in nuclear physics and chemistry. Among the uses of the multichannel analyzer will be the study of various radionucleides in atomic fallout	$297,952.00
	subcritical assembly,	The subcritical assembly will be used by the University Cantebury for training of nuclear engineering students	
	mass spectrometer, etc.	The Division of Nuclear Science of the New Zealand Government's Department of Scientific and Industrial Research will use the mass spectrometer, multichannel	

New Zealand Government's Department of Scientific and Industrial Research will use the mass spectrometer, multichannel

LETTER OF TRANSMITTAL FROM ATOMIC ENERGY COMMISSION

In your letters dated November 20, 1959, and January 6, 1960, you requested a report on the "Foreign Power Assistance Programs." * * *

I am happy to enclose with this letter two copies of a report on this subject prepared by the Commission's Division of International Affairs. * * *

U.S. ATOMIC ENERGY COMMISSION

"THE FOREIGN POWER ASSISTANCE PROGRAM"

I. The Program Defined

The development of economic nuclear power suitable for use in foreign countries as well as in the United States has been one of the most important objectives of the "Atoms for Peace" program since the program began in December 1953. During the early days of the atomic energy program it was recognized that there was a possibility that nuclear power could, in time, play a significant role in helping the United States as well as other countries meet their increasing energy needs. Accordingly, starting in 1954, the United States Atomic Energy Commission formalized and undertook a major program whose purpose was to develop the technology of nuclear power to a point where it could provide electricity on an economic basis within the United States. Concurrently, as noted in President Eisenhower's speech at Pennsylvania State University,[1] the United States initiated a series of steps which were principally designed (a) to assure that the results of the extensive reactor development program conducted in this country would be shared with the other countries of the world, and (b) to stimulate and assist the development of economic nuclear power abroad. The sum of these activities represents the assistance that the United States has provided to date to foreign countries in the development and application of nuclear power to serve their needs. It is the purpose of this paper to

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[1] "Within prudent security considerations, we propose to make available to the peoples of such friendly nations as are prepared to invest their own funds in power reactors, access to and training in the technological processes of construction and operation for peaceful purposes."

identify and describe those elements of United States policy which, in the aggregate, have formed, and now form, the "international atomic power assistance" program.

It should be noted that the development of reactor technology abroad is being enhanced by many facets of the overall Atoms for Peace Program, some of which are described more fully in other papers. This paper will emphasize those elements of the program which have been particularly significant or primarily oriented toward facilitating the development of nuclear power overseas.

II. Reducing the Uncertainties

At the outset of the international program in 1954, there were many imponderables associated with nuclear power, apart from unresolved technological questions. These included questions as to (1) the terms and conditions that would govern the transfers of special nuclear materials to other countries, (2) whether adequate quantities of special nuclear materials could be obtained from the United States at reasonable prices over a long-term period, (3) whether the United States might be prepared to purchase the by-product special nuclear materials produced overseas and, if so, at what prices, (4) whether adequate long-term reprocessing services might be available to foreign enterprises at reasonable costs, (5) whether capital loans could be obtained from the United States on conventional terms to assist in the financing of the extraordinary costs associated with nuclear power reactors, (6) whether reactor materials (such as heavy water) and services could be obtained readily under reasonable terms, (7) whether the

technical personnel who might participate in the construction and operation of the plants might be assured of satisfactory training, and (8) whether foreign nations could become reasonably conversant with the special precautions that would have to be taken to assure that the nuclear power plants were being safely located, constructed, and operated.

Satisfactory answers to these questions were obviously essential to the development and ultimate utilization of nuclear power plants in any country. Accordingly, the history of both the domestic and international aspect of the Commission's program since the passage of the Atomic Energy Act of 1954, in large part, is an accounting of the steps taken by the United States to remove uncertainties associated with this relatively new field. In several instances policies developed in the first instance with the domestic program in mind were extended and made applicable to the foreign program as well.

III. Basic Contribution of the Domestic Reactor Development Program

Perhaps most importantly, some introductory words should be said about the far-reaching contribution being made by the Commission's domestic reactor development program.

The U. S. Atomic Energy Commission's reactor development program has been and will continue to be this nation's most notable contribution to the ultimate development of economic nuclear power in other countries of the world. The objectives of this program have been to develop nuclear power to a stage where it would be economic in the United States and to improve

the effectiveness of American assistance to other countries in the nuclear power field. As a matter of basic philosophy it has been recognized that positive steps of assistance to other countries should be included as part of the reactor development program.

In view of the relatively inexpensive conventional sources of energy already available in this country, it generally has been assumed that nuclear power would have to achieve a greater efficiency in the United States than it would in other countries in order to be competitive on a wide scale. The requirement for a high degree of efficiency, in turn, has encouraged the Commission to undertake an ambitious and diversified research and development program that has been designed to determine the feasibility and relative merits of a variety of reactor concepts and then fully develop those offering the most promise.

The net result of this extensive effort has been the development of a comprehensive nuclear power development program and a fund of knowledge that should be of considerable value to all nations having a serious interest or need for nuclear power.

In addition, current planning in the United States has been based on the objective of reducing the costs of nuclear power generation to a point where they will be competitive with the costs of fossil fueled plants, in high energy cost areas in this country by 1968.

Because of the higher energy costs in several other countries, it has been assumed, in the past, that the achievement of this objective would also result in the availability of competitive nuclear power in such countries (starting with Western Europe) in about five years. Accordingly, because of the differential

in energy costs it has been expected that the fruits of the U. S. reactor development program might manifest themselves at an earlier stage overseas than they would in the United States. (Although this may still prove to be the case it should be noted that in the last two years the increased availability of fossil fuels and the drop in their shipping costs have brought the time table of achieving nuclear power, in such areas as Europe, closer to that of the United States.)

Conversely it has been recognized that a more rapid realization of economic nuclear power overseas also will be of considerable value to this country. The experience gained overseas should contribute ultimately to the realization of economic nuclear power in this country. For these reasons there has been a close interrelationship between the Commission's foreign activities and its domestic reactor development program. The foreign program both benefits from, and is designed to assist, the domestic program.

It also is to be noted that within the Commission's reactor development program a number of activities have been sponsored, at least in part, with the needs of foreign countries specifically in mind.

The joint U. S.-EURATOM program, for example, which is discussed later, was specifically designed to serve the interests of both U. S. and European industry through the construction and operation of relatively large-scale reactors of types carried to an advanced stage of development with the United States.

In addition, the programs pointed to the successful development of (a) plutonium and thorium recycling, (b) heavy water moderated reactors and, (c) graphite moderated reactors, have been designed, in part, to assist friendly foreign nations desiring to be independent of outside sources of enriched fuel. Similarly, the projects contemplated in theSecond Round of

the Commission's Power Demonstration Program, as well as the recently initiated small sized nuclear power plant program were developed with the realization that an economically competitive small or modest sized plant could be attractive not only in high cost areas in the U. S. but also to countries with high conventional costs and modest power demands.

Also, it has been hoped that, over the long-term, the Commission's thorium breeder program, will prove of value to countries that have expressed an interest in obtaining the full utilfzation of their thorium resources such as India and Brazil. Thus the U. S. civilian power program has been conducted with the realization that the resulting advances would benefit the foreign as well as the domestic program.

IV. Historical Developments

A. The Atomic Energy Act

The most significant step that was taken in developing a basis for a program of international cooperation after the President's U. N. speech of December 1953, was the enactment in August of 1954 of the Cole-Hickenlooper Bill.

Following the passage of the Atomic Energy Act of 1954, several major actions were taken by the United States to facilitate its ability to cooperate and share the benefits of its nuclear research with other countries.

Before these actions are described in further detail it is useful to note certain principles which have generally been applicable to the distribution of material or supply of services by the AEC almost since the inception of the international program.

First, to the extent possible, the Commission has endeavored to offer materials and services abroad at the same prices and under the same terms and conditions as have been applicable domestically.[2] As a basic principle, materials and services made available by the AEC also have been priced without profit or loss. In addition, the Commission will provide materials and services only to the extent they are not available commercially at reasonable prices. The objective in both the foreign and domestic programs has been to enhance both the status and commercial freedom of industry to the greatest extent practicable.

Another objective has been only to make materials of potential military significance available to foreign nuclear power programs under guarantees and appropriate safeguards designed to prevent their diversion to military purposes.

B. Negotiation of the First Agreements for Cooperation

The first Agreements for Cooperation were concluded in the summer of 1955. Most of these Agreements were rather simple in form and they were designed to cover the fuel and other requirements associated with transferring a research reactor overseas. It was noted, in such agreements, that the United States might ultimately assist the other countries in undertaking nuclear power programs.

More importantly, however, for the purposes of this paper, in the spring and summer of 1955, Agreements for Cooperation were negotiated and executed

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[2] An exception, as discussed later, is that special nuclear material for use in foreign power reactors has been transferred on a sale (or modified sale) basis whereas, material is to be leased domestically for such purposes. Section 53e of the Act specifies that the title to special nuclear material distributed domestically "shall at all times be in the United States".

with the three closest wartime allies of the United States in the nuclear field, the United Kingdom, Canada, and Belgium.[3] Each Agreement was designed to reflect the special and close relationship that had developed over the war and post-war period between the United States and the country involved. The Agreements with Canada and the United Kingdom were with countries which had developed sizeable nuclear programs on their own.

The Agreement with Belgium, in contrast, was with a country that was in the initial stages of developing its nuclear power program, and interested in receiving access to U. S. knowledge and experience. In some respects the Agreement with Belgium was the prototype for future "power" agreements since it set some of the basic patterns under which the U. S. would provide assistance to foreign countries in the development of their nuclear power programs.

In particular, the Belgian Agreement provided for unclassified as well as clearly delineated classified exchanges of information in fields related to the development of nuclear power (including health and safety problems related to various types of reactors), contemplated that the Commission would sell to the Government of Belgium, under terms to be agreed, such quantities of U-235 (of 20% or less enrichment) as Belgium required for use in research and power reactors, permitted the Government of Belgium

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[3] These negotiations are described more fully in a history of the Bilateral Agreement Program which has been jointly prepared by the USAEC and the Department of State.

to redistribute this material to authorized users in Belgium, contemplated that the USAEC would perform the reprocessing of any fuel elements fabricated from enriched or natural uranium obtained from the U. S., provided for the exchange of research and other materials not commercially available as well as the exchange of information, equipment, materials and devices between private parties, and gave the U. S. an option to purchase any special nuclear materials, in excess of Belgium's own needs for its peacetime program which were produced from material provided by the U. S.

In essence, the Agreement was designed to provide Belgium with access to the information and material it needed to formulate and develop its overall nuclear power development program. Following an identification of the reactors that Belgium was seriously interested in constructing, the details necessary for the design, construction and operation would be provided. Provision was made for the exchange of Restricted Data since some information of significance to the development of civilian nuclear power technology was still, at that time, in the classified realm.

C. Defining Terms and Conditions

During 1955 and 1956 the United States also took significant steps to (a) "normalize" and define the conditions under which American industry could transact business with the foreign governments and enterprises interested in the field of nuclear power and (b) provide potential foreign reactor operators with the information they required to make long-range

financial estimates. Some of the more notable steps are described in the following paragraphs:

1. Initial Prices for Materials

On the day the Geneva Conference opened, August 8, 1955 the Atomic Energy Commission announced a value for enriched uranium to be transferred to cooperating nations under bilateral agreements. Sale prices also were set for normal uranium and heavy water. The value of uranium enriched to 20 percent in uranium 235 was placed at $25 per gram of contained uranium 235. Normal uranium metal was priced at $40 a kilogram and heavy water at $28 per pound.

2. Authorization of Unclassified Activities

In November, 1955, the Atomic Energy Commission announced a general authorization, pursuant to Section 57(a)3 of the Atomic Energy Act, under which American firms or individuals could engage in any unclassified atomic activity with friendly countries without having to obtain specific Commission approval. This authorization vastly simplified the procedures governing unclassified cooperation with friendly foreign countries, and was designed to result in the development of closer cooperation between U. S. industry and foreign atomic energy organizations. Pursuant to Section 57(a)3b specific authorizations are still required before an American firm may undertake any activity which constitutes directly or indirectly engaging in the production of any special nuclear material in a subgroup A country (the USSR and Soviet bloc members).

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3. Allocation of U 235

On February 22, 1956, at the recommendation of the Atomic Energy Commission and with the Departments of State and Defense concurring, President Eisenhower announced that the Government would make available 40,000 kilograms of uranium 235 to assist industrial power development and research within the United States and to enable friendly countries to develop the peaceful uses of atomic energy. Of the uranium 235 allocated, 20,000 kilograms were earmarked for domestic use chiefly in power reactors, and 20,000 kilograms (in addition to 200 previously allocated) for research and power reactors in cooperating countries.

In making the announcement, the President said, "This action demonstrates the confidence of the United States in the possibilities of developing nuclear power for civilian uses. It is an earnest expression of our faith that the atom can be made a powerful instrument for the promotion of world peace."

The Presidential statement also pointed out that, as additional projects were undertaken by United States industry and by other nations, the Atomic Energy Commission would recommend that additional supplies of nuclear fuel be made available as became necessary.

In a statement issued simultaneously with the President's announcement, Chairman Strauss described the action as "the most important step toward peaceful uses of atomic energy since the passage of the Atomic Energy Act of 1954."

The statement noted that the Commission was authorized to provide

sufficient uranium 235 to meet the estimated requirements of the private and public power groups in the United States which had announced plans for constructing nuclear power plants; and could answer, in the affirmative, the "top-priority question" being asked by friendly nations--whether the United States would make fuel available for their nuclear power programs.

The Chairman's statement added: "We are now embarking on programs of aid in nuclear power development, extending beyond our previous programs of support of atomic energy research in the United States and abroad. Under these programs we will provide uranium 235 to support nuclear power development during the life of the licenses issued under our civilian applications program at home and the expected life of agreed power reactor projects abroad using our fuel."

This was the first of several actions the Commission took to provide foreign countries with reasonable assurance that their developing atomic energy programs would not be limited by the availability of fuel.

4. Power Bilateral Negotiation of 1956

In the spring and summer of 1956 Agreements for Cooperation covering exchanges in the field of nuclear power were negotiated and signed with Australia, Switzerland, and the Netherlands. (The terms of these agreements were for 10 years; they each provided for a "net transfer" of 500 kilograms of U-235, and they also provided for an exchange of Restricted Data in certain defined fields.) These arrangements were significant in that they (a) contained, for the first time, comprehensive safeguard

provisions to assure that the materials and equipment being supplied would not further any military purpose and (b) established the basic fuel provision which has subsequently been used, with minor modifications, in all Agreements for Cooperation covering nuclear power.[4]

In addition, and in recognition of the fact that reprocessing plants ultimately would be built overseas they also, for the first time, contained permissive language which would permit irradiated fuel elements to be reprocessed outside the United States in facilities acceptable to the Commission.

5. November 1956 Price Announcement

Although the Agreements that had been executed in 1956 provided a satisfactory overall framework for dealing with the individual countries involved, there still was considerable uncertainty regarding the major

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[4] In these agreements, the quantities of enriched U are arrived at through consultation with the cooperating nation, and are designed to be adequate to provide fuel over the life of the agreement for projects which, at the time, appear reasonably firm. Once these quantities are established, however, they need not be employed in the firm projects; rather, they are available for use in any defined project which the cooperating government, in consultation with the U. S., wishes to undertake.

The fuel quantities in such agreements are specified in terms of a net amount U 235 defined as the difference between the amount transferred to the cooperating nation less the amount returned to the U. S. over the life of the agreement. It covers the cumulative amount of U 235 consumed over the term of the agreement plus the amount in the reactor inventory and the overseas portion of the "pipeline." The amount of material in the U. S. portion of the pipeline (under fabrication, processing, etc.) is not charged against this total.

financial terms and conditions that would govern the transfer of special nuclear materials overseas for use in power or power demonstration reactors. This uncertainty had manifested itself in discussions with many representatives of foreign governments as well as members of interested industries in the United States. Accordingly, one of the most significant steps taken by the United States toward minimizing the uncertainties that faced foreign enterprises interested in proceeding with nuclear power programs was the announcement by the President on November 18, 1956, of the terms and conditions under which the fuel earmarked for the foreign program would be made available. Some of the notable features of this announcement were:

(a) the publication of a schedule of charges for uranium-235 which was the same as the price schedule for domestic users and based on the recovery of full costs. (Although these prices were not guaranteed, the Commission announced its intention to keep them as stable as possible.)

(b) the establishment of prices, based on the estimated fuel value of the materials, which the United States would pay for plutonium ($12 per gram) and uranium-233 ($15 per gram) produced in reactors fueled under bilateral agreements. (Subject to the availability of appropriations, the Commission offered to purchase, at the stated prices until June 30, 1963, all of the plutonium and uranium-233 produced abroad in reactors fueled with material obtained from the United States which was

offered to it and in excess of the needs of the cooperating nation for peaceful purposes.)

(c) a declared willingness of the USAEC to enter into or extend existing Agreements for Cooperation for a period beyond 10 years, (as had been the practice) so as to assure foreign purchasers that the enriched uranium they required would be available over the amortizable life of their facilities. (Subsequent to this announced policy, Agreements providing for a fuel supply over a 20 year period were negotiated with Italy, Japan, and for 25 years with EURATOM in 1957 and 1958.)

The net effect of this announcement was to permit potential reactor operators to make a more accurate assessment of the total costs of nuclear power projects. In addition, cooperating nations were further assured that they could count on receiving substantial amounts of U-235 from the United States, under reasonably stable terms, over a long-term period. The announcement also reiterated the point that it was the Commission's policy to sell rather than lease fuel for use in foreign power reactors.

6. Availability of Financing From the Export-Import Bank

In October 1956, the Atomic Energy Commission and the Export-Import Bank of Washington agreed upon joint action to assist the construction of atomic power plants and research reactors in nations having Agreements for Cooperation with the United States. In view of the relatively higher costs of nuclear as against conventional power, it was considered particularly

important to assure potential power reactor operators that adequate financing would be available to cover their needs.

Specifically, the Bank announced its willingness to consider loaning funds to cover the capital costs of nuclear power plants to privately owned public utility companies as well as to foreign governments. The announcement indicated that the terms for such loans would be similar to those for financing conventional power plants for which United States equipment and technical services are contracted. The Bank indicated that it would require for a project:

(a) a comprehensive engineering survey;

(b) a technical report by the Atomic Energy Commission on the reactor involved;

(c) an arrangement for availability of atomic fuels, through lease or sale by the Commission, for the term of the loan;

(d) evidence of overall financial and economic soundness;

(e) evidence of the availability of funds to defray the cost which must be met with local currency; and

(f) an assurance as to the ability of the country concerned to service the dollar debt involved.

The announcement indicated that the proceeds of any loans could be spent only for equipment, materials and technical services to be exported from the United States.

D. Financing Fuel Inventories

Throughout the foregoing period considerable thought was given to the question of whether it would be appropriate for the Commission to sell or lease fuel for use in foreign power reactors. The Commission concluded that the material should be sold for power reactors, generally for the following reasons:

(a) the cost of the fuel inventory was considered part of the capital cost of the facility and hence one that should be borne by the owner of the facility.

(b) the material was expensive and the value of the fuel inventory in the aggregate could reach billions of dollars when atomic power came into general use; and

(c) it would be unwise for the Commission to establish a precedent that might lead to its financing very large sums of money overseas (which more appropriately was a banking function.)

In view of these considerations, study was given in the Executive Branch to alternate sources of financing fuel inventories. As a result of these discussions the U. S.-Export-Import Bank, informally indicated its willingness in November 1957 to consider financing the fuel inventories of foreign reactors.

E. Fuel Allocation of July 1957

On July 3, 1957 the President approved the release of an additional 59,800 kilograms of uranium 235 for the foreign and domestic program. With the 200 kilograms that had been released for foreign use prior to 1956 this action brought the total amount allocated for peaceful applications to

100,000 kilograms of which 50,000 kilograms was earmarked for the foreign program. The Commission also has reiterated on several occasions that it would be prepared to request additional allocations if they are necessary. According to current prices the 50,000 kilograms allocated to the foreign program to date has a value of approximately $850,000,000. These factors, together with the favorable uranium supply situation in the United States and elsewhere, indicate that no serious concern need be felt as to the future availability of enriched uranium to cover all demands on the United States that are foreseeable at this time.

F. Declassification of Civilian Nuclear Power Technology

One of the most significant developments in the Atomic Energy Program since 1946 has been the almost continuous declassification of information of potential interest both domestically and overseas to the development of civilian nuclear power.

Between 1946 and 1954 the United States, Canada, and the United Kingdom jointly revised their tripartite classification guide on six different occasions. Since the passage of the Atomic Energy Act of 1954, four additional major revisions were adopted.

In 1955 the Commission declassified a significant body of information needed for the design and construction of research reactors, including nuclear data, chemical processing of fuel elements, and processing of raw materials. This action manifested itself in the release of information

in over 500 U.S. papers which were prepared for the Geneva Conference of 1955. Further, in December 1955, an accelerated program to review documents for potential declassification was conducted. Of some 31,000 documents reviewed, about 11,000 were declassified.

In 1956, the eighth revision to the joint classification guide was adopted. This revision made it possible to declassify almost all information on non-military and non-production reactors, including research reactors, civilian power reactors and test and experimental reactors. Accordingly the new policy went far toward enabling domestic and foreign industry to design, construct and operate civilian power reactors entirely on an unclassified basis. In 1957 a second special review project (applying the 1956 guide) was conducted and about 18,000 documents were reviewed of which 9,000 were declassified.

In 1958 research related to Controlled Thermonuclear Reactions was declassified entirely and the technology of plutonium alloys containing up to 90 atomic percent plutonium and useful as reactor fuels was also declassified. In addition depleted uranium and a uranium price schedule were declassified.

Thus, important technical and economic data has been released progressively on all facets of the program ranging from uranium mining to the chemical processing of spent reactor fuels. The consequences for the foreign program have been very significant since it is now possible to provide essentially all reports received from AEC-sponsored civilian reactor development projects on an unclassified basis.

Accordingly, since 1957 no new Agreements for Cooperation providing for an exchange of Restricted Data on the civil uses of atomic energy have been executed. Those countries that previously entered into classified agreements are now able to receive their required information more readily.

G. Chemical Processing

The only important service in the nuclear fuel cycle not commercially available in the United States at present is the processing of spent irradiated fuel and the related task of storage or disposal of radioactive wastes. As a consequence, on February 18, 1957, the Commission announced that it was prepared to enter into contracts with domestic reactor operators for fuel processing through June 30, 1967, subject to the condition that the AEC could terminate the contracts upon one year's notice if processing sources became commercially available at reasonable prices.

When this announcement was made in 1957 the Commission did not have the legal authority to enter into similar long-term processing contracts with foreign reactor operators. However, with the passage of P. L. 85-681 in 1958, the Commission was empowered to enter into long-term reprocessing contracts with foreign enterprises on the same basis as with domestic reactor operators.

H. Availability of Natural Uranium from Private Producers

On May 8, 1958 the Commission announced that natural uranium could be obtained directly from private producers in the United States. Previously, because of contractural commitments between the Commission and private producers, such material generally could be obtained only from the United States Atomic Energy Commission.

I. Other Developments

During the periods described above a number of other notable developments occurred:

1. In late November 1956, at the request of the Belgian Government, the AEC undertook the sponsorship of a power reactor symposium at the new Belgian nuclear research center at Mol in order to provide special assistance to the Belgian Government in furthering the establishment of that country's power reactor program. AEC scientific specialists presented, for the information of the official Belgian staff, a wide variety of technical information pertinent to the Belgians' programmatic interests. The symposium, which included the presentation of classified data on power reactor technology and related subjects, was preceded by an unclassified meeting held in Brussels under the auspices of the Atomic Industrial Forum, of which the Belgian Center for Application of Nuclear Energy is a member.

2. An unclassified power reactor agreement was negotiated with Norway in December which would permit the exchange of power reactor technology on an unclassified basis. The agreement provided for the transfer over a 10-year period of 500 kilograms of uranium 235 enriched up to 20%. In addition the Belgian power agreement was amended as of January 18, 1957, to permit a broader exchange of data on methods of producing and utilizing reactor materials and on fabrication of reactor components.

3. In May, 1957 a broad unclassified symposium on the chemical processing of irradiated fuel elements was conducted at Brussels with

the assistance of the USAEC and at the invitation of the Government of Belgium. A comprehensive review of significant United States developments in this field by technical specialists was presented. There were 108 representatives from 14 countries present; 24 from the United States, 37 from Belgium, and 47 from 12 other foreign countries.

4. In the summer of 1957 comprehensive power agreements with the Federal Republic of Germany, the Netherlands, the Union of South Africa, and a major amendment to the French were negotiated and executed. The arrangements with Germany, France, and the Netherlands were designed to cover their immediate fuel requirements pending the coming into operation of the EURATOM supply mechanism.

5. A comprehensive agreement for cooperation with Italy, providing for the transfer to Italy of 7,000 kilograms of uranium 235 over a 20 year period, for use in research and power reactors, which was also signed in the summer of 1957, went into effect on April 15, 1958. The 7,000 kilograms included fuel for the several projected reactor projects.

6. The Second International Conference on the Peaceful Uses of Atomic Energy also was held in Geneva, Switzerland from September 1-13, 1958, and as in the case of the First Conference in 1955, provided a great stimulus to the exchange of technical information, which would complement the exchanges under the bilateral agreements for cooperation. An additional result of the conference, as it affected the power agreement program, was a series of

subsequent meetings and visits to European countries for technical discussions of mutual interest to bilateral partners.

7. A comprehensive agreement for cooperation with Japan, superseding the 1955 research reactor agreement with that country became effective on December 15, 1958. The new agreement provided for the transfer to Japan of 2,700 kilograms of uranium 235 (net) over a 20 year period for use as fuel in research and power reactors. Among the projects planned by the Japanese were a 15,000-to-20,000 electrical kilowatt experimental power reactor scheduled for operation in 1961, and a full-scale 150,000 electrical kilowatt power reactor scheduled for operation in 1964.

J. The Development of Further Incentives

As will be noted from the foregoing discussion from 1955 through 1958, a number of important steps were taken by the United States to establish the basis for cooperating with other countries in the field of nuclear power. The technology of civilian nuclear power developed to date was declassified, steps were taken to liberalize and define the conditions under which American industry could engage in nuclear commerce overseas, and the United States took a number of important steps to assure potential foreign reactor operators that they would be able to obtain the required materials and services under terms analagous to those available to the domestic industry.

These contributions to the development of the technology of nuclear power abroad also were supplemented by

(a) establishing special cooperative exchange programs in the field of reactor development with such countries as the United Kingdom, and Canada.

(b) arranging for foreign scientists and engineers to visit, on a recurrent basis, facilities and projects engaged in the U. S. civilian reactor program.

(c) providing routine and specialized training in the field of nuclear power to foreign nationals (such as the Argonne International School and the Shippingport Reactor Operators Course);

(d) providing foreign governments and potential reactor operators with important advice and counsel on matters pertaining to health, safety, and regulatory responsibilities--such as reactor hazards evaluation and waste disposal;

(e) convening additional specialized symposia and conferences such as those described above designed to orient foreign countries on various aspects of nuclear power technology.

These additions, (some of which are described in further detail in other papers) when taken in the aggregate, constituted one of the most impressive and concerted efforts made by any nation to acquaint others with an emerging, new technology.

As the international program progressed the belief also developed that there were some countries outside of the United Kingdom (notably in Western Europe) where nuclear power was apt to be competitive at an earlier stage than in the United States. In addition, on the assumption that these areas might be disposed into undertaking significant nuclear power programs of interest to the United States, it was concluded that the interests of the U. S. reactor development program might be served through a close association with such programs.

More significantly in the period of 1956 and 1957 the concept of a "European Atomic Energy Community" emerged as an important part of the post-war European "integration" movement.

K. The United States-Euratom Joint Nuclear Power Program

From the early beginnings, the United States had lent its support to the integration movement and on several occasions it had expressed its strong support of the European Atomic Energy Community and its interest in developing a close association with EURATOM once it came into being.

Accordingly, starting in 1956 serious consideration was given to the proposition of fostering and providing special assistance to the Euratom Community once it came into being. Concurrently

there was a growing feeling that the specific interests of both the United States and EURATOM could be served by the development of a closer association between the reactor development programs of Europe and the United States. These factors ultimately lead to the formulation of the joint Nuclear Power Program between the United States and the European Atomic Energy Community.

The detailed developments which lead to the formulation of the Joint Program are the subject of separate paper which has been jointly developed by the Atomic Energy Commission and the Department of State. Only the highlights are reported here.

(1) "A Target For EURATOM"

Following the Suez crisis, there was a growing belief in Europe that Europe would face a serious energy crisis unless dramatic steps were taken to develop some alternate source of power. With this problem in mind the governments of Belgium, France, Germany, Italy, Luxembourg, and the Netherlands commissioned three prominent Europeans, Louis Armand, Franz Etzel, and Francesco Giordani to report on the prospects and desirability of producing nuclear power in the six countries, and the means that should be employed for this purpose. As is now generally known, Messrs. Armand, Etzel and Giordani analyzed the problem and concluded that the economic

growth of the six countries was in danger of being seriously hampered by the lack of another source of energy. At the time their report was written, Messrs. Armand, Giordani and Etzel found that the six countries involved were importing the equivalent of 100 million tons of coal per year, or nearly a quarter of their energy supplies. According to their estimates these imports would double in 10 years and treble in 20 unless an alternate source of energy was developed.

The authors of "A Target for EURATOM", noting Suez felt that this dependence would place Europe in a hazardous position because of the apparent instability of some of her existing sources of supply. Their analyses led them to conclude that Europe could stem this apparent rising tide of insecurity by building nuclear instead of new conventional power stations using imported oil or coal. The objective would be stabilize fuel imports in the Community to a reasonable level or around 165 million tons of coal equivalent a year.

In order to achieve this it was recommended that the EURATOM countries strive for the installation of 15 million kilowatts of nuclear power capacity in the next decade. At the time it was recognized that the nations involved would not be able to achieve this goal without pooling their resources and receiving the help and guidance of the more technologically advanced countries such as the United States, the United Kingdom and Canada.

(2) Development of the Joint Program

Although there was a belief, at the time, that the goal established in the "Target for EURATOM" was probably too optimistic when the Community

came into existence in January 1958 it was agreed that the industries of Europe would have to obtain some immediate experience in the operation of full-scale nuclear power-plants if they were to move ahead in pursuit of the longer range objective of building the number of plants required to satisfy the long-term energy demand.

It was also recognized that the United States would have much to gain if it closely associated itself with the European effort to gain such experience.

As a logical first step, accordingly, it was concluded that it would be in the interest of both the European Atomic Energy Community and the United States immediately to undertake the joint sponsorship of a program that would have as its objective the rapid installation of a limited number of large-scale reactors which would serve to provide the technological foundation for a larger scale program to follow. The initial program had to be large enough to provide a sufficient number of industries with the desired experience.

Accordingly, it was in this context that the United States and EURATOM agreed in the spring and summer of 1958 to undertake a program which had the following objectives.

"a) To bring into operation within the European Atomic Energy Community (Euratom) large scale power plants using nuclear reactors of types on which research and development have been carried to an advanced stage in the United States, having a total installed capacity of approximately one million

kilowatts of electricity by December 31, 1963 (except that two reactors may be selected to be in operation by December 31, 1965) and under conditions which would approach the competitive range of conventional energy costs in Europe;

"b) To initiate immediately a joint research and development program centered on these types of reactors;".

In formulating the program it was realized that the maximum support of the industries in the community and the United States would have to be obtained if the desired objectives were to be achieved on schedule. Although it was recognized that the United States already had taken some major steps to provide foreign governments with basic assurances it was concluded that the program would not move ahead at the desired pace unless some special incentives were made available. It was agreed, that the major remaining uncertainties, existing at the time, should be minimized and the terms should be made attractive enough, in terms of anticipated costs, to encourage sufficient participation in the program.

After much discussion of various possible approaches to the problem (including informal suggestions from U. S. industry) it was concluded that the most desirable approach would be one under which the European utilities would accept the risks for the total capital costs, most of the operating costs and for those associated with reactor on-stream time. The United States, in turn would:

(a) assure EURATOM of a long-term and adequate fuel supply;

(b) would sell the initial fuel inventory to EURATOM under attractive terms (i.e. deferred payment);

(c) would assist in the capital financing through a low interest, long-term line of credit of $135,000,000;

(d) would agree to purchase, at its fuel value price and over a ten-year period, the plutonium (4100 kilograms) which was expected to be produced by the reactors in the program, less any amounts retained by Euratom for its civil needs or purchased by the IAEA, which was granted a first option.

(e) would provide fuel element processing services under the same conditions offered to domestic reactor operators in this country.

In addition, the United States would assure the reactor operators over a ten year period of a guaranteed fuel fabrication cost for their elements as well as a guaranteed fuel life. These guarantees, were at the time considered to be among the most important incentives offered inasmuch as studies at the time suggested that fuel cycle costs constituted the major unknown in nuclear power economics due to the uncertainties associated with fuel element life and fabrication costs.

As part of the joint program the United States and Euratom also undertook a program of research and development focused on improving the performance of reactors to be constructed under the joint program, and lowering fuel cycle costs. This joint program was formulated with the expectation that it would last for a period of ten years. During the first five years, the

financial contribution of each party would amount to a total of about $50 million each. It was agreed that Euratom funds would be spent primarily in the European Community and that U. S. funds would be spent primarily in the U. S. However, selection of research and development projects proposed under the joint program would be made jointly.

Following extensive Congressional hearings the concept of the joint program was approved by Congress and the EURATOM Cooperation Act of 1958 became law on August 28, 1959. The United States-EURATOM agreement for Cooperation, in turn was signed in November and came into effect on February 18, 1959.

Following approval of the program the United States amplified its diplomatic mission to the European Atomic Energy Community to include senior AEC and Department of State personnel who would be concerned with the added responsibilities associated with administering the joint program. On December 23, 1958, Euratom and the U. S. Mission also announced the formation of a joint Research and Development Board and solicited proposals for research and development under the joint program.

Further, on April 13, 1959, Euratom and the U. S. Mission issued an invitation for reactor project proposals under the joint program outlining the conditions and criteria to be considered by a Joint Reactor Board in selecting projects. Such proposals initially were due by September 1, 1959, but at the request of Euratom, this date was postponed to October 20, 1959.

The response for research and development work under the joint program was generally enthusiastic. By the end of 1959, over 350 definitive or

preliminary proposals and letters of intent had been received from American and European concerns desiring to participate in this phase of the program. Of approximately 250 definitive proposals, half were from European sources. The remaining number were about equally divided between U. S. and U. S.-European joint proposals.

By the end of 1959, 23 proposals had been formally accepted by the joint Research and Development Board.

The invitation for reactor proposals had solicited indications of interest by May 28, 1959, from Euratom utilities desiring to submit proposals by October 20 for projects to be completed by December 31, 1963. On May 28, 1959 letters of interest in participating in the program were received from 6 Euratom utilities.

However, on October 20, the deadline for submission of proposals, only one proposal was received from the Italian utility Societa Electtro-Nuclear Nazionale (SENN) which purported to be fully responsive to the conditions of the Invitation. Communications were received from four other utilities, however, which indicated varying degrees of readiness and interest in continuing to participate under the Joint Program. None of those projects, however, has manifested itself in a firm proposal.

The disappointing response had not been entirely unexpected, inasmuch as there had been growing evidence that the fossil fuel situation had changed for the better in Europe since the basic objectives and incentives for the joint program had been formulated in March of 1958. In the intervening period

a number of developments had the effect of reducing the sense of urgency for undertaking a large-scale nuclear power program in Europe or to lessen the attractiveness of the incentives under the program.

First Europe developed a sizeable surplus of coal and important new discoveries of oil were found. In addition the Middle East experienced a relatively significant relaxation of tensions. These factors tended to depress the overall costs of conventional power and stimulate a belief that Europe's long-term nuclear power program should proceed at a more leisurely pace.

In view of the foregoing developments the joint program with EURATOM is now under study. Although the results to date have been less than hoped for the United States has confidence that, as years progress, EURATOM and the United States will have fruitful cooperation in fields related to the development of nuclear power and other applications. This would appear to be a natural outgrowth of the heavy concentration of scientific and technical resources in the Community.

L. The Deferred Payment Program

When the joint program with EURATOM was formulated it was recognized that additional countries outside of the European Atomic Energy Community might have a requirement for similar forms of assistance to help them through the initial phases of their nuclear power programs.

Discussions with potential reactor operators as well as manufacturers of nuclear equipment in this country had indicated that the initial heavy capital costs associated with the purchase of enriched nuclear fuel was

proving to be an obstacle in the financing of a number of nuclear power projects abroad during this relatively early stage of nuclear development. (The same obstacle does not obtain in the United States, where under the Atomic Energy Act of 1954, enriched uranium is leased, rather than sold to nuclear power plant operators.)

It also was recognized, that as was the case for the joint program with EURATOM, the United States also would benefit from experience gained in foreign projects outside of the joint program and elsewhere in the world. Accordingly, with these considerations in mind, on February 2, 1959 the USAEC announced a limited program under which the Commission would make enriched power reactor fuel available on a deferred payment basis to countries and international organizations, including the IAEA, having Agreements for Cooperation with the United States.

The plan provides foreign reactor operators with the use of the reactor fuel inventory for a period of up to 10 years without payment of the principal. Payment of the principal is to be spaced over the second 10 years of operation. The interest on the unpaid balance is to be the same as the use charge for special nuclear material in effect in the United States at the time of the payments. Fuel consumed will be paid for on a current basis. To be eligible for participation in the program, the reactor plants must be scheduled for operation before June 30, 1964, and make use of U. S. designs and a substantial portion of U. S. components. The plan will be restricted to nuclear power projects with a combined generating capacity of up to 500,000 kilowatts.

To date, one large-scale reactor project, the 167 MWE SELNI project in Italy, has been approved for inclusion under the program. In addition, inquiries to include projects under the program have been received from Sweden, Spain and Japan but there are no pending firm proposals. At the last General Conference of the International Atomic Energy Agency, the United States also reiterated the fact that the benefits of the program were available to Agency projects. In view of the criterion that projects must be scheduled for operation before June 30, 1964 and the normal construction period, it is expected that firm proposals will have to be furnished to the Commission by June, 1960 if the projects hope to qualify under the program.

M. Assistance to the International Atomic Energy Agency

The Agreement for Cooperation between the United States and the IAEA was signed at Vienna May 11, 1959 and entered into force August 7, 1959. It provides that the U. S. will make available to the Agency for use in Agency activities 5,000 kgs of contained U-235 together with amounts of special nuclear material which will match in amount the sum of all quantities made available by all other Members of the Agency prior to July 1, 1960. Special nuclear material will be made available to the Agency at the USAEC's published charges applicable to U. S. domestic distribution of such material.

Following the terms of its Statute[5] the International Agency has devoted its attention to studies on the potential use of nuclear power in the less developed areas of the world.

The Agency's program of assistance to the less developed countries in the field of nuclear power was inaugurated in October, 1958 by Resolution 27 of the Agency's Second General Conference. The Board of Governors adopted a program of action and the Third General Conference approved this program and the progress to date in Resolution 57 of October 1959.

The present program of action by the Secretariat may be briefly described as follows:

(1) Technical and economic studies, including nuclear costing

The Agency staff is now performing a general evaluation of different power reactor types with reference to their use in less developed areas.

(2) Conference on small and medium power reactors

A conference is scheduled for September 5-9, 1960, to deal with the technical aspects, costs and potential use of small and medium power reactors in less developed countries.

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[5] Article III A of the Statute of the International Atomic Energy Agency states that the Agency is authorized:

"....To make provision, in accordance with this Statute, for materials, services, equipment, and facilities to meet the needs of research on, and development and practical application of, atomic energy for peaceful purposes, including the production of electric power, with due consideration for the needs of the under-developed areas of the world;

(3) Nuclear power surveys

Twenty countries have expressed an interest in having the Agency survey their nuclear power needs and as a first step they have received a detailed questionnaire from the IAEA.

Four Agency survey missions also have surveyed the power situation in 11 countries; and

The Board has approved Agency participation in power studies to be conducted in Finland and Argentina in 1960.

At the Third General Conference (1959), the United States agreed to assist the Agency in its survey of the needs of the less developed countries for nuclear power and in its evaluation of reactor types best suited to their economic development of such countries. Specifically the United States Atomic Energy Commission expressed its interest in developing a program with the IAEA which would permit Agency personnel to participate directly in the U.S. small sized nuclear power plant program. The U.S. also recommended that the Agency undertake a worldwide study of the economics of reactor systems using thorium.

N. Third Party Liability

The question of providing adequate protection to the public and to suppliers of reactor equipment in the event of harm resulting from a nuclear incident has been a major concern to the Atomic Energy Commission. It was recognized at the commencement of the "Atoms for Peace" program that its full and free development would be contingent upon achieving an equitable distribution of the potentially great risks involved. The extent to which American industry is willing to participate in foreign activities is directly proportional to satisfactory protection from liability for injury resulting from a nuclear incident.

Given the inability of the private insurance market to provide a sufficiently high level of protection, it has been recognized as incumbent upon governments to assume the risk up to a certain amount above the insurance level. The AEC has continuously, over the past seven years, stressed with its foreign associates, the necessity for governmental action either through national legislation or adoption of an international convention.

There are several specific areas in which the U.S. has taken an active role. Chronologically, they are as follows:

1. The U.S. has been represented from the outset (1957) in an advisory capacity, in the efforts of the OEEC to develop a third party liability convention. It is believed that the expression of U.S. views in this work has been instrumental in developing views on important principles among the other participants consonant with ours. The OEEC convention is now nearing completion.
2. In developing the joint program with Euratom, specific understanding was reached with Euratom in Article IX of the U.S.-Euratom Agreement for Cooperation that concerted efforts would be made by the Community to develop and secure adoption of suitable measures to protect equipment manufacturers, other suppliers, and participating utilities against third party liability. A Euratom convention is being developed which will be dependent on, and supplement, the OEEC convention.
3. The United States has had a private expert participating on a panel convened by the International Atomic Energy Agency to draft an international third party liability convention. The efforts of this panel

are nearly completed and it is expected that its proposed convention will be submitted to governments for consideration in the near future.

4. The International Maritime Committee, consisting of national organizations whose membership is composed of representatives of shipping interests and the maritime law field, has developed a draft convention applicable to nuclear ships. The U.S. government has been active in this effort by offering informal advice to private U.S. citizens active in the IMC. In this field the U.S. government has also strongly supported the plans of the IAEA to convene a panel to consider the drafting of an international convention.

O. Study by the Atomic Industrial Forum

Despite the important steps that the United States has taken to assure other nations that an ample amount of U-235 can be relied upon to satisfy their foreseeable nuclear power needs a few countries have displayed some doubts as to whether large amounts could be relied upon to cover sizeable nuclear power programs they might wish to undertake in the foreseeable future. Similarly, at various times, the assertion has been made that the current U.S. price is subsidized and susceptible to radical upward adjustment. In view of these circumstances it is significant that on November 4, 1959, the Chairman of the United States Atomic Energy Commission, in his address to the Atomic Industrial Forum's Annual Conference assured his Washington audience that partially enriched uranium fuel can be supplied for nuclear power in quantities sufficient to meet the most optimistic forecast of future requirements' without affecting the defense effort as presently foreseen, and added:

"'I can further assure you that the established price of enriched uranium fuel is not and never has been a subsidized price. The government policy is to price fuel consistent with full costs of production. Therefore, I would not expect increases in the Commission schedule of fuel prices barring of course extreme changes in our economy such as an uncontrolled inflation or rising rates of interest.'

"Mr. McCone said a decision had been made to keep production figures classified, after reexamination of the question, but issued the following invitation:

"'Realizing how important all this is to you, I have suggested to your Forum that it appoint a small committee to examine the facts that support this statement (that enriched uranium costs are extremely unlikely to rise) ....this committee.....will be given access to information sufficient to enable it to give you an independent evaluation of the statements I have just made. I believe such an evaluation will allay fears expressed to me by some with respect to both the availability and cost of nuclear fuel.'

"In accordance with this invitation, the Atomic Industrial Forum's Board of Directors appointed an ad hoc committee consisting of K. D. Nichols, Consultant; Percival F. Brundage, retired partner, Price, Waterhouse and Co.; and William Webster, President, New England Electric System.

Following meetings with the Commission Staff the Forum committee stated:

"We have reviewed the data furnished by the Atomic Energy Commission pertaining to uranium ore reserves, procurement of ore, refining of ore, conversion of UF 6, and production of uranium enriched to various degrees of U 235. A review of these data indicates that the published prices for U 235 do not include any Government subsidy....

...."A review of anticipated U 235 requirements, both military and commercial, and a review of ore reserves, United States refining capacity, and the United States U 235 separation capacity indicate that there can be U 235 supply available to support both the inventories required and the continuing burnup requirements for a commercial atomic power capacity of at least forty million kilowatts. For the purpose of estimating, it was assumed that the build-up of

> this capacity would extend over the next fifteen years. This capacity of forty million kilowatts does not, however, include the additional atomic power capacity that might be supported by the use of plutonium or natural uranium as a fuel .....
>
> "The above conclusions indicate that no new major plant construction for U 235 separation capacity will be needed for at least the period indicated .....

The Forum study and its conclusions should do a great deal to alleviate any remaining doubts as to the ability of the United States to satisfy the fuel requirements of foreseeable requirements for enriched uranium in foreign countries.

IV. Conclusion

In summing up it is to be noted that over the past six years the United States has taken notable steps to share the benefits of its existing reactor development program with other countries and to define and limit the major uncertainties now facing potential reactor operators and foreign governments interested in undertaking nuclear power programs.

Although a substantial number of power reactors have not been authorized or constructed yet in most foreign countries, a number of the necessary conditions have been established to facilitate their undertaking as soon as the economics are sufficiently attractive. As time and experience develops and as additional plants and projects come into being in this country and overseas, it is expected that any remaining uncertainties will be further minimized and that the economics will become sufficiently certain and attractive to encourage many countries to seriously consider undertaking nuclear power programs using reactors of U. S. design.

The United States is now supporting the most comprehensive reactor development program in the world and there is every confidence that this program will prove of inestimable benefit to foreign countries as well as the domestic economy. Unprecedented steps have been taken to share this technology with individual nations and international organizations such as the International Atomic Energy Agency, EURATOM and the OEEC.

Similarly important experience gained in various foreign projects is being made available or should benefit the United States in its domestic program. Continued planning and study is being given to additional steps that should be taken to further stimulate the development of the technology in selected areas of the world and continuous consideration is being given to the development of special cooperative arrangements that promise to be of benefit to the foreign country involved and the United States.

In these studies an increasing amount of attention is being devoted to programming meaningful research and development projects with other countries which promise to be of substantial mutual benefit to both parties. A number of the programs in various states are now getting underway and as a consequence, it is expected that an increasing number of fruitful cooperative arrangements will develop.

54953 O—60—vol. 2——23

LETTER OF REQUEST TO ATOMIC ENERGY COMMISSION

The paper titled "Foreign Power Assistance Programs," in a discussion of the deferred payment program, stated "In view of the criterion that projects must be scheduled for operation before June 30, 1964, and the normal construction period, it is expected that firm proposals will have to be furnished to the Commission by June 1960 if the projects hope to qualify under the program."

Could you, due to the short time apparently left to this program, furnish * * * a short supplemental statement setting forth its status, in terms of projects approved or pending?

TRANSMITTAL LETTER FROM ATOMIC ENERGY COMMISSION

* * * I am sending you herewith information concerning the present status of the AEC's deferred payment plan, to supplement that previously supplied in our paper describing the "Foreign Power Assistance Program."

Status of the AEC's Limited Deferred Payment Program

Five countries have requested participation or expressed interest in the AEC's limited deferred payment program: Italy, Sweden, Japan, Spain and Switzerland.

The Italian SELNI (Societa Elettronucleare Italiana) is the only one that has qualified and been accepted for the program's benefits; acceptance took place in January 1959. The project will include a 164-electrical-megawatt pressurized water reactor to be built by Westinghouse.

The Swedish Atomic Energy Co. proposed two reactor projects for possible consideration under the program. In keeping with a basic objective of the program, however, which was to achieve an equitable geographical distribution of projects, the Swedes were asked to assign a priority to one of the two projects. They have, on an informal, oral basis, chosen a 60-electrical-megawatt boiling water reactor project for which the "Atomkraftkonsortiet Krangede A.B. & Co." (AKK Atomic Power Group) is negotiating with United States (GE) and Swedish companies. The Swedes also indicated that they probably would not be able to complete construction of this project by the 1964 deadline and thus would request extension of the established time limit. Currently, a formal request from the Swedes is expected, which will provide the Commission with a basis for a decision on the project and the extension question.

Representatives of the Japanese Government have recently made informal inquiries concerning the deferred payment program. In conversations, the Japanese posed the question of the possible eligibility of a 12-electrical-megawatt boiling water type power demonstration reactor which the Japanese Atomic Energy Research Institute is negotiating to procure from General Electric. Although the Japanese were informed about the features of the program, a formal request has not yet been submitted to the United States for its consideration.

Discussions have taken place with representatives of the Spanish and Swiss Governments about the possibility of participating in the deferred payments program in connection with proposed power reactor projects in their countries.

LETTER OF TRANSMITTAL FROM ATOMIC ENERGY COMMISSION

In your letters dated December 7, 1959, and January 6, 1960, you requested * * * a history of the bilateral agreements for cooperation program.

I am happy to enclose * * * the paper prepared by the Division of International Affairs on "International Cooperation in the Peaceful Uses of Atomic Energy Through the Instrument of the Bilateral Agreement for Cooperation."

INTERNATIONAL COOPERATION IN THE PEACEFUL USES OF ATOMIC ENERGY THROUGH THE INSTRUMENT OF THE BILATERAL AGREEMENT FOR COOPERATION

In response to the request of President Eisenhower for an amendment to the existing legislation governing atomic energy activities in the United States, the United States Congress passed the Atomic Energy Act of 1954. The new legislative authority provided the legal framework within which the United States Government established its policies and procedures for providing assistance to other nations and groups of nations in this field.

This paper describes the evolution of the broad cooperative program utilizing bilateral "Agreements for Cooperation" which was developed by the United States following the enactment of the 1954 Act. Examples of the types of cooperative activities that have been developed with countries from various parts of the world under the terms of such bilateral Agreements for Cooperation are also included. Appended to this report is a list of the Civil Agreements for Cooperation which the United States has negotiated with other nations and international organizations since 1955.

Early Forms of International Cooperation

Prior to the passage of the Atomic Energy Act of 1954, there had been international cooperation in the field of atomic energy (1) during World War II with the United Kingdom and Canada on the military application of atomic energy, and the procurement of uranium for the common defense; (2) during and after World War II with several friendly countries

in the exploration for and procurement of uranium, and (3) from 1951 to 1954 for a limited classified exchange of technology with Canada in the field of reactor development, and with foreign sources of raw materials in uranium and thorium processing.

The Quebec Agreement of August 1943, which was the basic accord for wartime atomic energy cooperation among the United States, United Kingdom and Canada, established a Combined Policy Committee composed of representatives of the three countries to provide general direction and policy guidance for the joint effort. In June 1944, an "Agreement and Declaration of Trust," between the United Kingdom and United States created a Combined Development Trust under the Combined Policy Committee, comprising representatives of the United States, United Kingdom and Canada, to direct the exploration for, development and procurement of uranium and thorium oxide outside the CPC member countries. Subsequently the Combined Development Trust became known as the Combined Development Agency.

From 1944 until the end of the war, overseas procurement activities were carried on by the CDT and, subsequently, by the CDA for the joint benefit of the U.S. and the U.K. Canada, as a uranium producer with limited requirements, did not actually participate in the procurement agreements, but did itself supply uranium to this country.

At the conclusion of World War II, there was a growing preoccupation with the need to establish effective controls over the development of nuclear armaments. This in turn led to a belief in the need to control the dissemination of nuclear weapons technology. In the United States

this resulted in the enactment of the Atomic Energy Act of 1946, which prohibited the exchange of classified information with other nations in the military and industrial application of atomic energy and thus ended the wartime technical exchange with the United Kingdom. In order to clarify the relations among the United States, the United Kingdom and Canada which were established by the Quebec Agreement of 1943 but overtaken by the Atomic Energy Act of 1946, representatives of the three governments agreed to a Modus Vivendi in 1948, which superseded the provisions of the Quebec Act; acknowledged the restrictions of the 1946 Act; continued the joint ore procurement program by the CDA under CPC direction; and provided for a limited exchange of technology with the United Kingdom and Canada.

The ability of the United States to engage in international cooperation was extended by a 1951 Amendment to the Atomic Energy Act of 1946 which provided the Executive Branch with the authorization to engage in a limited classified exchange of information with other countries in the "refining, purification and subsequent treatment of source materials, reactor development, production of fissionable material, and research and development related to the foregoing." The primary beneficiaries of the amendment were (1) Canada, which had continued to transmit information to the United States despite U.S. restrictions under the 1946 Act and which was to be provided information from the United States in all categories, and (2) countries which were sources of raw materials and which required a knowledge of uranium and thorium processing techniques in treating such materials. The 1951 amendment also established four principles, which

guided the development of future civil Agreements for Cooperation when the Atomic Energy Act of 1946 was revised in 1954. These principles were (1) a prohibition against communication of weapons design and fabrication data; (2) the need for adequate security standards in countries receiving classified information; (3) a determination by the President that the arrangements would promote and would not endanger the common defense and security; and (4) a requirement that the Joint Committee on Atomic Energy be informed of the arrangement 30 days prior to its consummation.

Enactment of the Atomic Energy Act of 1954

In February 1954 President Eisenhower transmitted to Congress his request for amendment of the Atomic Energy Act of 1946 which would provide the following:

> "First, widened cooperation with our allies in certain atomic energy matters;
>
> "Second, improved procedures for the control and dissemination of atomic energy information; and
>
> "Third, encouragement of broadened participation in the development of peacetime uses of atomic energy in the United States."

The Atomic Energy Act of 1954, which became effective on August 30, 1954, provided the mechanism for the initiation of a broad program of international cooperation with other nations or groups of nations on the development of the peaceful applications of atomic energy.

One of the six major programs or objectives set forth in the revised Act was the establishment of:

> "A program of international cooperation to promote the common defense and security and to make available to cooperating nations the benefits of peaceful applications of atomic energy as widely as expanding technology and considerations of the common defense and security will permit."

In addition to defining the objectives, the Act went on to define the limits and procedures for maintaining this cooperation with other states. In particular, the Act specified that certain types of cooperation would have to be conducted under executive agreements which are described as Agreements for Cooperation. The pertinent facts in the legislation are summarized in the following paragraphs:

> "Sec. 123. Cooperation with Other Nations - No cooperation with any nation or regional defense organization pursuant to Sections 54, 57, 64, 82, 103, 104, or 144 shall be undertaken until -
>
> 'a. the Commission or, in the case of those agreements for cooperation arranged pursuant to subsection 144b, the Department of Defense, has submitted to the President the proposed agreement for cooperation, together with its recommendation thereon, which proposed agreement shall include (1) the terms, conditions, duration, nature, and scope of the cooperation;

> (2) a guaranty by the cooperating party that security safeguards and standards as set forth in the agreement for cooperation will be maintained; (3) a guaranty by the cooperating party that any material to be transferred pursuant to such agreement will not be used for atomic weapons, or for research on or development of atomic weapons, or for any other military purposes; and (4) a guaranty by the cooperating party that any material or any Restricted Data to be transferred pursuant to the agreement for cooperation will not be transferred to unauthorized persons or beyond the jurisdiction of the cooperating party, except as specified in the agreement for cooperation;
>
> 'b. the President has approved and authorized the execution of the proposed agreement for cooperation, and had made a determination in writing that the performance of the proposed agreement will promote and will not constitute an unreasonable risk to the common defense and security; and
>
> 'c. the proposed agreement for cooperation, together with the approval and the determination of the President, has been submitted to the Joint Committee and a period of thirty days has elapsed while Congress is in session (in computing such thirty days, there shall be excluded the days on which either House is not in session because of an adjournment of more than three days)'."

In outlining the specific types of international cooperation which could be undertaken only under the terms of such agreements, the Act further specified that the communication of Restricted Data (Section 144), the export of production or utilization facilities (Section 101), the distribution of special nuclear materials to another country (Section 54) could take place only pursuant to the terms of an Agreement for Cooperation. Persons were prohibited from directly or indirectly engaging "in the production of any special nuclear material outside of the United States," except under an Agreement for Cooperation or upon a specific Commission authorization (Section 57a(3)). Within these statutory

limitations, the first Agreements for Cooperation were negotiated and executied in the spring and summer of 1955.

Negotiation of the "Special" Agreements with Belgium, Canada and the United Kingdom for the Exchange of Classified "Power" Technology

Because of the close cooperation which had existed during World War II between the United States and the United Kingdom and Canada, as well as Belgium's notable contribution to the war effort through the supply of Congo uranium, the United States began concurrent negotiations with the governments of these countries in the fall of 1954 on the first classified agreements for cooperation centered on the development of nuclear power. Each of these agreements reflected the special relationship that the United States had previously maintained with these countries.

On June 15, 1955, the three agreements were transmitted separately to the President for his approval and for submission to the Joint Committee on Atomic Energy for the required 30-day waiting period. The agreements, each of a ten-year term, became effective on July 21, 1955.

In general, the three agreements provided for a broad exchange of both classified and unclassified information related to current or planned projects in the other countries. As a major limitation the agreements prohibited an exchange of Restricted Data primarily of military significance. The agreements did not require the exchange of information which the Parties were not permitted to communicate because it was privately developed, privately owned or received from another government.

The scope of the information exchange provision in each agreement varied because of differences in the objectives, requirements, status of technology of each of the three countries, and their relationships to the United States. Because of the modest requirements of the Belgian nuclear energy program, the scope of the exchange, provided in the Agreement with the Government of Belgium, was limited to classified and unclassified (1) "general information on the over-all progress and economics of power reactor programs," and (2) "technological information required for the construction of specific reactors for the Belgian power program in Belgium, the Belgian Congo and Ruanda-Urundi." The following areas of reactor information were included: specifications for reactor materials, properties of reactor materials, reactor components, reactor physics technology, reactor engineering technology, and environmental safety considerations. Unclassified information related to the production of reactor materials such as heavy water, zirconium and hafnium was also to be exchanged.

Due to the highly advanced status and scope of the British program, the areas of information exchange in the Agreement with the United Kingdom were broader than the Belgian agreement and provided for a reciprocal exchange of classified and unclassified information on research, experimental power, demonstration power and power reactors; uranium and thorium technology; properties of materials; technology of the production and utilization of materials from laboratory experimentation up to pilot plant operations; and health and safety. The Canadian agreement included not only

the fields of exchange provided for in the agreement with the United Kingdom but also an exchange of information relating to production reactors, military power reactors in the development of a joint U.S.-Canadian early warning radar system, and instruments, instrumentation and devices useful to the subjects of the agreed exchange.

The provisions covering the transfer of special nuclear materials varied in the three agreements. Inasmuch as the United Kingdom possessed its own facilities for enriching uranium and hence did not appear to require substantial quantities of enriched uranium reactor fuel from the United States, special nuclear materials to be supplied by the United States to the United Kingdom under the terms of the original Agreement for Cooperation were limited to quantities for use for research purposes only. (This was later interpreted to permit the transfer of fuel for research reactors manufactured in the United Kingdom under license with a U.S. manufacturing firm.)

In addition to allowing for the transfer of research quantities of special nuclear and other materials, the Agreements for Cooperation with Belgium and Canada (neither of which possessed facilities for enriching uranium) provided for the sale of uranium-235 required in the power reactor program in Canada and for use in research and power reactors located in Belgium, the Belgian Congo and Ruanda-Urundi. Although no maximum quantities of U-235 were specified, the amounts of fuel transferable under the Belgian and Canadian agreements were subject (1) to the limitations imposed by the maximum quantities of U-235 available for such distribution by the

U.S. AEC during any year; and (2) to the limitation that the total quantity of U-235 of weapon quality in the possession of Belgium or Canada under the Agreement would not be of military significance. The Belgian and Canadian agreements also contained provisions for the sale by the United States to these countries of natural uranium and heavy water; and the agreement with the United Kingdom provided for the sale of materials other than special nuclear materials in general, as might be agreed.

In addition, the Canadian and United Kingdom agreements provided for the mutual use of research and reactor testing facilities, but not including those primarily of military significance.

The "Research" Agreements for Cooperation

Concurrent with the start of negotiations on the special power agreements with Belgium, Canada, and the United Kingdom, mentioned above, Ambassador Henry Cabot Lodge announced to the United Nations General Assembly on November 5, 1954, that the United States Government was prepared "to start discussion with other countries for the conclusion of bilateral agreements which will make it possible for us, under our laws to furnish technical information, technical assistance, and necessary amounts of fissionable material for the construction and operation of research reactors to be located abroad." Inasmuch as, under the terms of the Atomic Energy Act of 1954, a research reactor and its fuel could only be exported pursuant to the terms of an Agreement for Cooperation, an unclassified form of agreement was developed, which was designed to assist countries wishing to undertake modest nuclear programs centered largely in the initial phases around the use of research reactors.

The use of research reactors had demonstrated their utility for training, education, basic research, medical therapy, radioisotopes production, reactor engineering, and reactor physics. Providing the framework for making such a tool available to foreign countries under an agreement for cooperation therefore seemed to be the most beneficial method of assisting the development of atomic energy programs in those countries interested in initiating their nuclear programs on a relatively modest scale.

U.S. experience in the construction and operation of several different types of research reactors had revealed the types of fuels that would be required to assure their effective operation. In determining the fuel requirements, it was believed that six kilograms of uranium-235 enriched up to 20%, and provided on a lease basis, would meet the needs of cooperating nations in the initial phase of the Atoms for Peace program. The 20% enrichment and six kilogram limitation represented an optimum requirement, and would provide a satisfactory neutron flux (10^{12} to 10^{14}n/cm^2/sec.) in properly designed, small scale reactors. The six kilogram quantity would permit the cooperating nation to plan for one pool-type reactor or for more than one smaller reactor. Providing the material on a lease rather than a sale basis also would reduce the costs to foreign operators and consequently would be an important benefit to foreign research, training and development. It was also decided, in safeguarding the nuclear materials against diversion to military purposes, that the cooperating nation would provide the U.S. with the right to verify the

use of the fuel being leased to assure that it was not being diverted to military purposes and should return irradiated fuel elements to the United States for chemical reprocessing.

The first "research" agreement to go into effect was the one with the Government of the Republic of Turkey. Turkish interest in such an agreement was first indicated to a group, including members of a subcommittee of the Joint Committee on Atomic Energy and U.S. Ambassador Morehead Patterson, principal U.S. negotiator on International Atomic Energy Agency matters, who visited Turkey in December 1954.

During the following month, the Turkish Government expressed its desire to develop a cooperative agreement with the United States, and invited the U.S. to send technical representatives to Turkey to discuss atomic energy developments. In March 1955, Dr. Lawrence R. Hafstad, Director of the Division of Reactor Development of the U.S. Atomic Energy Commission, who was traveling abroad under the auspices of the Fund for Peaceful Atomic Development, a non-profit organization, visited Turkey in an unofficial capacity to discuss the subject of research reactors with representatives of certain Turkish educational institutions. The visit also provided the Turkish Ministry of Education the opportunity to learn of the various types of reactors and their role in training and research. The representatives of Turkey then expressed an interest in concluding an agreement with the United States that would permit them to acquire a research reactor and other assistance necessary to establish a small nuclear research program.

The Agreement for Cooperation with Turkey, which went into effect on June 10, 1955, provided for the following:

(a) The exchange of unclassified information on research reactors and their applications; health and safety problems related thereto; and the use of radioactive isotopes in various fields.

(b) The lease by the United States, on such terms and conditions as may be mutually agreed, of up to six kilograms of contained U-235 in uranium enriched up to a maximum of 20% U-235.* When requiring replacement, the fuel elements containing such U-235 would be returned to the U.S. for reprocessing without alteration of the form and content of the irradiated fuel elements and replaced by new fuel elements.

(c) The sale or lease of reactor materials not available commercially, other than special nuclear materials. Examples of such materials are heavy water, beryllium, zirconium, etc.

(d) The transfer and exportation of materials, including equipment and devices, and performance of services by private parties in either country.

(e) A prohibition against the transfer of Restricted Data.

*Subsequent research agreements provided for the transfer of such additional quantity as, in the opinion of the Commission, is necessary to permit the efficient and continuous operation of the reactor or reactors while replaced fuel elements are radioactively cooling "in the Cooperating Country," or while fuel elements are in transit, it being the intent of the Commission to make possible the maximum usefulness of the six (6) kilograms of said material.

(f) The maintenance of nuclear material safeguards by the recipient government, including the keeping of specified records and transmission of annual reports to the Commission.

(g) Subsequent consultation between the Parties on the feasibility of an additional agreement for cooperation with respect to the production of nuclear power.

(h) A clause specifying that the duration of the agreement would be for a ten-year period.

Congressional hearings on the Turkish agreement revealed the desirability of modifying future research agreements to limit the life of agreements to five years instead of ten (as in the case of Turkey). As a result, all research agreements subsequently negotiated, except the agreement with the Government of the Republic of Korea, reflected this modification. Other provisions of the Turkish accord were included in subsequent agreements which were executed with the following countries: Argentina, Austria, Brazil, Chile, Republic of China, Colombia, Costa Rica, Cuba, Denmark, Dominican Republic, Germany, Greece, Guatemala, Iran, Israel, Italy, Japan, Korea, Lebanon, New Zealand, Pakistan, Peru, Philippine Islands, Portugal, Spain, Sweden, Thailand, Uruguay, Venezuela, Viet-Nam, and West Berlin.

An agreement concluded with Switzerland in July, 1955, covered the sale to that country of the U.S. "swimming pool" research reactor, which was a central feature of the official United States Government exhibit

at the First International Conference on the Peaceful Uses of Atomic Energy, held in Geneva, Switzerland, in August 1955, under the sponsorship of the United Nations.

On the opening day of the Geneva Conference, August 8, 1955, the United States announced a value for enriched uranium leased to other countries under bilateral agreements. The leased value of uranium enriched to 20% in U-235 was placed at $25.00 a gram. Heavy water was offered for sale at $28.00 a pound and natural uranium was to be sold at $40.00 a kilogram.

The Need for Amendments to the Research Agreements

As the programs of countries with whom the United States had entered into research reactor agreements became clearer and more advanced, additional requirements for special nuclear materials arose which necessitated amendments to several research agreements.

For example, in 1956 the United States Government recognized the needs of certain nations for increased quantities of U-235 fuel for additionally planned research reactors beyond those that would be permitted by the 6 kilograms that had been provided thus far in research agreements. Accordingly, amendments to the research agreements with Denmark, the Federal Republic of Germany, and Sweden increased the quantity of uranium-235 which could be transferred to each country from 6 to 12 kilograms, plus the amounts needed to assure continuous and efficient operation while the fuel elements were replaced. A later amendment to the research agreement with Brazil raised the maximum quantity of 20% uranium-235, which could be transferred to Brazil, from 6 to 15 kilograms. It was

understood that such amendments would be concluded only where there was a clear justification for doing so.

In addition to the need for increased quantities of reactor fuel, several cooperating nations in 1956 expressed a requirement for limited quantities of special nuclear materials for research purposes that were not related to the use of research reactors. This resulted in a revision of U.S. materials policy and an amendment of a number of original research agreements, to permit the transfer of limited quantities of special nuclear materials to the other countries for use in general research projects.*

A major revision in fuel policy occurred in 1956, when the AEC, recognizing the fact that high flux reactors required highly enriched fuel for their most efficient operation, approved a policy permitting the transfer of contained uranium-235 enriched up to 90% in the isotope U-235 for use in a materials testing reactor capable of operating with a core loading of up to six (6) kilograms. Transfers of this type were to take place pursuant to agreements for cooperation containing comprehensive controls and safeguards fashioned after those contained in Article XII of the Statute of the International Atomic Energy Agency. As a result, a number of agreements were amended to include these new provisions.

AEC policy of making highly enriched fuel available to other countries was liberalized in April 1958 to include research, as well as

*The applicable provision of the Agreement stated that "in no case, however, shall the quantity of special nuclear materials under the jurisdiction of the foreign government, by reason of transfer under this Article, be, at any one time, in excess of 100 grams of contained U-235, 10 grams of plutonium, and 10 grams of U-233."

materials testing reactors. Under this policy revision, which was announced on April 25, 1958, 90% fuel could be made available for certain research reactors using up to eight kilograms per core loading, plus the additional fuel required for pipeline, burn-up and inventory purposes pursuant to bilateral agreements with comprehensive provisions when it was considered economically and technically advantageous. Ninety percent fuel could also be made available for more than one materials testing reactor under this policy revision.

In response to the need abroad for enriched fuel for reactor experiments, the Atomic Energy Commission in July 1959 revised its policy again to make available up to eight kilograms of U-235 enriched up to 90% in the isotope U-235 for use in reactor experiments generally producing less than 10 thermal megawatts. Comprehensive safeguards provisions were also to be included in Agreements providing for such materials transfers. In revising its policy AEC recognized that the use of highly enriched fuel is often technologically advantageous, as it may allow the construction of smaller and therefore more economic experimental facilities than if 20% fuel were used. A reactor experiment is defined as "a project designed for the limited purpose of testing the technical feasibility of a reactor concept or some unique reactor feature or piece of equipment."

On January 1, 1960, research agreements were in effect with 31 foreign nations and West Berlin. In addition, research agreements with Costa Rica, Iraq, and Panama were awaiting an exchange of notes by their respective governments. As of that date, 38 research reactors had been built or were

under construction by U.S. manufacturers for foreign countries under Agreements for Cooperation with the United States. Twenty of these were already in operation.

The "Power" Agreements Program Covering Specific Projects in Cooperating Countries

In a speech at Pennsylvania State University on June 11, 1955 President Eisenhower announced a new program intended to assist nuclear power development in power-short areas of the world:

> "Within prudent security considerations, we propose to make available to the peoples of such friendly nations as are prepared to invest their own funds in power reactors, access to and training in the technological processes of construction and operation for peaceful purposes."

Interest in such a program was exhibited by several other countries which, toward the end of 1955, initiated negotiations with the United States on an Agreement for Cooperation. Concurrent with these negotiations and in anticipation of the fuel assurances that other nations would require before they could embark on sizeable nuclear power programs, President Eisenhower, on February 22, 1956, upon the recommendation of the Atomic Energy Commission and with the Departments of State and Defense concurring, announced that the United States would make available 40,000 kilograms of uranium-235 at the unit prices announced at the Geneva Conference in August 1955 to assist industrial power development and research within the United States and to enable friendly countries to develop the peaceful uses of atomic energy.

The Presidential statement pointed out that, as additional projects were undertaken by American industry and by other nations, the Atomic

Energy Commission would recommend that additional supplies of nuclear fuel be made available as became necessary.

Of the uranium-235 allocated, 20,000 kilograms were designated for domestic use chiefly in power reactors, and 20,000 kilograms (in addition to 200 kilograms previously allocated) for research and power reactors in cooperating countries. The uranium was to be distributed under conditions prescribed by the Commission.

When additional allocations were later required, President Eisenhower set aside the following uranium-235 for peaceful uses:

1. 30,000 kilograms for use in the United States, through lease for licensed civilian purposes, principally for power reactors.
2. 29,800 kilograms for use outside the United States, through sale or lease, to governments of individual nations or to groups of nations with which the United States concludes agreements for cooperation.

This action raised to 100,000 kilograms the total amount of uranium-235 available for peaceful purposes, divided equally between domestic and foreign uses, and subsequently enabled conclusion of several agreements providing for large quantities of fuel.

The First "Power" Agreements Associated with Specified Project Requirements

In June 1956, negotiations were concluded with the Governments of Australia, the Netherlands and Switzerland on the first Agreements for Cooperation, providing for the transfer of nuclear materials and technology for specifically defined power reactor projects. The agreements

provided for the transfer of Restricted Data, specified quantities of special nuclear materials and other types of assistance under appropriate security and safeguard provisions.

Restricted Data to be exchanged included: (1) general information on research reactors, as well as experimental, demonstration power or power reactors to permit evaluation and comparison of the potential use and relative merits of various reactor types in a power production program; (2) technical information as might be agreed on specific research reactors and on experimental, demonstration power or power reactors required by the cooperating nations; and (3) the exchange of classified information on: reactor materials, specifications and properties; reactor components, reactor physics and engineering technology; and environmental safety considerations. In addition the Australian agreement provided for a special area of exchange on source materials technology. Restricted Data primarily of military significance was not to be exchanged.

Special nuclear materials to be sold to each country under the terms of these agreements included a net amount* of 500 kilograms of contained U-235 in uranium, enriched up to 20% U-235 for use in research and power reactor projects. The AEC could, however, make available up to six kilograms of the U-235 in material enriched up to 90% for use in a materials testing reactor. The United States was also given a first option on special nuclear materials produced in reactors, fueled with U.S. material which was not to be used by the other country in its program for the peaceful

*Net amount was considered to be the gross quantity of contained U-235 in uranium sold or leased to a foreign country during the period of the Agreement, less the quantity of contained U-235 in recoverable uranium resold or otherwise returned to the U.S. Government during the period of the agreement or transferred to any other nation or international organization with the approval of the U.S. Government.

uses of atomic energy and the right to approve the transfer of such material to any other nation or international organization in the event the option to purchase was not exercised.

Subject to the restrictions of space, facilities and personnel conveniently available, the U.S. and its bilateral partners agreed to make available to each other specialized research facilities and reactor materials testing facilities, when such facilities were not commercially available.

The first power agreements also contained provisions for (1) direct relations between private individuals and organizations in the cooperating nations; (2) general patent arrangements covering inventions or discoveries resulting from the exchange of Restricted Data; (3) security and safeguards arrangements to protect classified information and equipment, and nuclear materials from diversion to military purposes; (4) future consultation with respect to transferring such rights or responsibilities of the agreement, particularly those relating to controls and safeguards to the International Atomic Energy Agency as might be mutually agreed, and (5) disclaiming any warranty by the communicating Party of the accuracy and completeness of information, material, equipment or devices transferred under the agreement and of its suitability for any particular use or application. The term of each agreement was ten years.

In response to a request from the Government of France for assistance in its research and development program, the United States Government also concluded in June 1956 an unclassified agreement providing for an exchange of technology on both research and power reactors and a transfer of 40 kilograms of uranium-235 for specifically defined reactor projects.

Information to be exchanged concerned unclassified technology on research, experimental power and power reactors, health and safety problems related thereto and the use of radioactive isotopes and radiation. The agreement also provided for the transfer of research quantities of nuclear materials in the amount of 100 grams of contained U-235, 10 grams of plutonium and 10 grams of U-233.

An important stimulus to the development of nuclear power abroad, and atomic energy in general, was the joint declassification of information, held by the U.S., Canada, and the United Kingdom, as a result of their wartime cooperation in atomic energy development. In 1955 a significant amount of information related to research reactors, including nuclear data, chemical processing of fuel elements and raw materials processing, was declassified and released at the First Geneva Conference. This was followed in December 1956 by a similar action, enabling the declassification of almost all information on non-military and non-production reactors, including research, test, experimental and civilian power reactors, and in 1958 by a declassification action concerning technology related to controlled thermonuclear research, as well as that of plutonium alloys containing up to 90 atomic percent plutonium, useful as reactor fuels.

An unclassified power reactor agreement was subsequently signed with Norway (in February 1957) which would also permit the exchange of power reactor technology on an unclassified basis. The agreement provided for the transfer over a 10-year period of a net quantity of 500 kilograms of uranium-235 enriched up to 20%. Six kilograms of the total quantity could upon request and at U.S. discretion be made available as highly enriched

uranium for use in a materials testing reactor. Of the amounts provided for, the Halden Reactor Experiment, a 10-to-20 megawatt installation for research in boiling heavy water reactor cores, was expected to require some 150 kilograms of uranium-235 of low enrichment. Two additional 100 megawatt reactors were planned within the life of the agreement and were estimated to require 350 kilograms of uranium-235. The agreement provided further for the transfer of research quantities of special nuclear material up to 100 grams of contained U-235, 10 grams of plutonium and 10 grams of U-233.

The Belgian power agreement was amended as of January 18, 1957, to permit a broader exchange of data on methods of producing and utilizing reactor materials and on fabrication of reactor components.

The Larger Quantity Power Agreements

By the beginning of 1957 the power reactor plans of certain countries had become clearer and resulted in the initiation of negotiations with the United States Government on an agreement for cooperation providing for a comprehensive exchange of unclassified technology on both research and power reactors and for the transfer of large quantities of enriched uranium fuel for specific power projects. Specifically, the Governments of France, the Federal Republic of Germany, Italy, and the Union of South Africa requested such an arrangement. Resulting agreements with these countries superseded previously existing arrangements, except in the case of the Union of South Africa, which had had no such prior arrangement.

The agreements with France, Germany, and Italy -- members of the European Atomic Energy Community -- were considered as interim arrangements to take care of the immediate needs of those countries for specific

quantities of fuel pending the establishment of the Euratom Supply Agency.

The possible assumption by Euratom of certain rights and obligations vested in member states under their individual agreements with the United States was recognized in the agreements with the insertion of a clause which read:

> "It is recognized that Article 106 of the Treaty Constituting the European Community for Atomic Energy (EURATOM) which the Government signed on March 25, 1957 in Rome contemplates that member states of the Community will seek a renegotiation of existing agreements in the field of atomic energy with third countries once the Treaty comes into force. If the Treaty comes into force and if a cooperative arrangement is executed between the European Community for Atomic Energy, and the Government of the United States of America would be prepared to arrange for the European Community for Atomic Energy to assume the rights and obligations of the _____ Republic under this Agreement provided the European Community for Atomic Energy could, in the judgment of the Government of the United States of America, effectively and securely carry out the undertakings of this Agreement."

The agreements with the three members of the Euratom Community and the agreement with the Union of South Africa contained provisions similar to the 1956 agreement with France except for the larger quantities of fuel. Maximum net amounts of contained uranium-235 to be transferred under the terms of the agreement were: 7000 kilograms to Italy over a 20 year period; 2500 kilograms to France and Germany over a 10 year period; and 500 to South Africa over a 10 year period. Of these total quantities the United States could, upon request and in its discretion, make available six kilograms of U-235 enriched up to 90% for use in a materials testing reactor.

The 7000 kilogram figure for Italy was based on the fuel requirements (over a twenty year term) for several large scale power reactor projects

and five research reactor projects. The total quantity of 2,500 kilograms of nuclear material in the German agreement was based on the need for 440 kilograms for the proposed 15 MWe Brown-Boveri high temperature gas cooled reactor project, 460 kilograms for the 15 MWe RWE boiling water reactor project, 1,490 kilograms for the 100 MWe Siemens Schuckert pressurized heavy water and 80 kilograms for the German research reactor program. Nuclear material requirements in the French agreements were identified as follows: 105 kilograms for research reactors, 217 for test reactors, 1,971 for power reactors and 50 for contingency purposes.

A request for assistance from the Spanish Government led to the negotiation of an unclassified comprehensive agreement for cooperation for both research and power reactor projects, which went into effect in February 1958. Similar to other comprehensive agreements negotiated previously, the Spanish agreement called for a transfer of 500 kilograms of fuel for specified reactors.

A comprehensive agreement for cooperation with Japan, which superseded the 1955 research agreement, became effective in December 1958. The new agreement provided for the transfer to Japan of 2,700 kilograms of uranium-235 over a 10-year period for use as fuel in research and power reactors. Among the projects planned by the Japanese which would require enriched uranium were a 15,000-to-20,000 electrical kilowatt experimental power reactor scheduled for operation in 1961, and a full-scale 150,000 electrical kilowatt power reactor schedule for operation in 1964. Both of these reactors are tentatively planned as enriched-uranium, water-cooled types.

On January 1, 1960, there were "power" agreements for cooperation in effect with 13 countries. As of the same date there were three power or power demonstration reactors under construction in foreign countries by U.S. manufacturers, viz., the BR-3 in Belgium, the RWE reactor in Germany, and the SELNI reactor in Italy. Contract negotiations were also under way for construction of three more reactors.

Agreements with the International Organizations

Increased attention by the United States Government to the objectives and programs of newly established international organizations manifested itself in 1959 in Agreements for Cooperation with the European Atomic Energy Community (EURATOM) and the International Atomic Energy Agency (IAEA).

The Agreement for Cooperation with Euratom, which became effective on February 18, 1959, provided the over-all framework for a joint power demonstration program and related research and development effort. The proposed program envisaged the establishment within the Community of a total capacity of one million electrical kilowatts in nuclear plants by 1965.

An agreement for cooperation with the International Atomic Energy Agency, which is basically the instrument under which the United States can supply nuclear materials and other equipment to the Agency, or to Agency projects, was negotiated and placed into effect August 7, 1959. A more detailed discussion of the arrangements with Euratom and IAEA may be found in separate papers on the subject in this over-all study.

Collateral Policies of Technical Assistance

In the development of the bilateral agreements program over the past five years, a number of supporting policies have been adopted. Several of these policies and programs are described in further detail in other reports. A summary of those more important policies follows:

1. In the field of information exchange the United States has (a) made available to cooperating nations atomic energy libraries, comprising unclassified data published up to the time of presentation, and has agreed to provide additional unclassified AEC reports as they are published in the future; (b) undertaken a series of declassification actions removing from the Restricted Data category large bodies of information relating to such fields as reactor development, chemical reprocessing, and fuel fabrication; (c) sponsored, co-sponsored, or participated actively in several important conferences, symposia, and exhibitions throughout the world.

2. In matters related to the availability of nuclear materials, some of the policies which were adopted (beyond those already mentioned) were: (a) the announcement in August 1955 of a reasonable schedule of charges, terms, and conditions under which uranium and heavy water could be made available for foreign use, including prices which the United States would pay for plutonium and uranium-233 produced in reactors fueled under U.S. bilateral agreements; (b) the announced willingness of the Export-Import Bank to consider applications for loans necessary to finance the capital costs associated with the construction of nuclear power plants overseas; (c) the expressed willingness of the United States to make enriched power

reactor fuel available on a deferred payment plan to those countries and international organizations which have agreements for cooperation with the United States providing for the supply of such fuel. The plan is limited to a total number of nuclear power projects having a combined generating capacity of up to 500,000 kilowatts and which are scheduled for operation by June 30, 1964; (d) the expressed willingness of the Commission to chemically process fuels irradiated in U.S.-built reactors abroad while such services are not available commercially in the United States; (e) leasing of nuclear materials abroad for use in exponential and subcritical assemblies and in defined reactor experiments.

3. A number of other forms of assistance included:

a. The assignment of AEC personnel

(1) to key U.S. Embassies abroad to serve in a liaison capacity with foreign programs;

(2) to foreign installations to assist in program planning and with the start-up and operation of reactor and other projects; and

(3) to U.S. technical missions sent abroad on a short term basis upon request by foreign governments to carry out surveys and to provide advice on a range of subjects, e.g., design of hot labs, reactor siting, radioisotope utilization, and feasibility of atomic power programs.

b. Financial assistance

(1) through an offer to pay one-half of the cost, up to a maximum of $350,000, of research reactor

projects, constructed pursuant to bilateral agreements with the United States;

(2) by an offer of financial grants for other equipment, such as exponential assemblies, radioisotope laboratories, etc.; and

c. Training of foreign nationals at various centers in the United States, including the International Institute of Nuclear Science and Engineering at the Argonne National Laboratory, and the Oak Ridge Institute of Nuclear Sciences; and

d. Assistance in reactor hazard evaluations at the request of foreign nations.

Present Attitudes Toward Bilateral Agreements

It is noted that, as of January 1, 1960, there were bilateral agreements in effect with 42 countries, West Berlin, and two international organizations, viz., Euratom and the IAEA. In addition, there were 8 bilateral agreements, or amendments to agreements, pending completion of ratification procedures. Although it is anticipated that several of those countries, whose research agreements with the United States are due to expire this year, will renegotiate and extend their agreements, it is not expected that many new agreements will be negotiated with additional countries.

The establishment of the International Atomic Energy Agency as a viable, functioning organization has resulted in an examination of U.S. policy toward international cooperation with individual countries. Inasmuch as the Agency now has the capacity to supply nuclear materials to

54953 O—60—vol. 2——25

member countries, the United States Government has adopted the policy of strongly encouraging other countries requesting quantities of special nuclear material from the U.S. to draw upon the Agency's available quota of materials to satisfy their additional needs. Nations requesting extensions to their agreements are also being encouraged in the first instance to satisfy their needs through the IAEA, if it appears that the Agency can satisfy the needs on a timely basis.

The United States also reaffirms its dedication to the concept of an effective international safeguards system administered by the Agency and its intention to seek transfer of its bilateral controls to the Agency when the Agency is prepared to render this service effectively.

Cooperative Activities with Selected Countries

In order to provide the reader with a summary of the types of cooperative programs that have been developed under the bilateral program the following sections briefly describe the cooperative activities that have been conducted with the following countries.

1. Belgium
2. United Kingdom
3. Canada
4. Denmark
5. France
6. Germany, Federal Republic of
7. Italy
8. Netherlands
9. Japan
10. Switzerland
11. Brazil
12. Argentina
13. Israel
14. China, Republic of
15. Thailand

For further information on the specific programs and U. S. relationships with these and other countries, the reader is referred to the separate paper, entitled "Summaries of the Atomic Energy Programs and Cooperative Activities with Selected Countries."

BELGIUM

Cooperation between the United States and Belgium in atomic energy began in 1940 with discussions that lead to a common understanding between the two governments as to the desirability of controlling for the protection of man uranium ores, wherever located. During and after the war the Belgian Government made available to the United States and the United Kingdom vitally important quantities of uranium produced in the Belgian Congo, and so made a unique contribution to the defense of the Western World. It was always understood, however, that Belgium would reserve for itself such quantities of uranium ores as might be required for its own scientific and industrial purposes, and would participate in the development of nuclear power on equitable terms with the United States and the United Kingdom when these two governments decided to use such ores for commercial power.

On July 21, 1955, an Agreement for Cooperation, recognizing Belgium's special relationship with this country, was signed between the United States and Belgium. This Agreement, and that with Canada, signed on the same day, were the first two power agreements entered into by the United States. Unlike subsequent power agreements, the Belgian bilateral contained no quantitative limitations on the net amount of enriched uranium that could be transferred by the United States. It provided for exchange of classified information on power reactor technology, which at the time was still largely in the classified area. The Agreement has been twice amended, in 1956 and 1959 -- the

Belgium

first time, primarily to broaden the areas of information exchange; and the second, primarily to harmonize the fuel Article with those of the other EURATOM member states.

Even prior to the signing of the Agreement, however, the Commission cooperated with Belgium by fabricating the core of the BR-1 natural uranium, graphite moderated, air cooled research reactor, which went into operation in the summer of 1956. The core itself, containing approximately 15 tons of natural uranium slugs, was shipped to Belgium on September 10, 1953.

Under the direction of the Commissariat a l'Energie Atomique, the Belgian Centre d'Etudes de l'Energie Nucleaire (CEN) has built, and now operates, the Mol Laboratory, 50 miles northeast of Brussels. In addition to the BR-1 research reactor, the Laboratory contains the 50 MWT BR-2, high flux materials testing reactor, which went critical in December 1959, and the 11.5 BR-3 pressurized water power demonstration reactor, scheduled to begin operation in the first part of 1960. The Laboratory also contains a plutonium metallurgy facility, and its scientific and technical personnel have been intimately engaged in the EUROCHEMIC reprocessing plant, under construction at a site near Mol.

The United States has supplied enriched uranium for the BR-2 reactor and will supply the enriched uranium for the BR-3. Since the beginning of 1955, almost 200 Belgians have visited Commission facilities, and 122 scientists and engineers have received training in

Belgium

AEC schools or on specialized assignments in AEC facilities. The Commission sent consultants to Mol to assist in setting up and operating the plutonium research and development laboratory there, while an Oak Ridge physicist spent a year at Mol in charge of the physics program.

The United States has committed a $350,000 research reactor grant for the BR-2 reactor and has provided hazards evaluation assistance for this reactor as well as the BR-3. Two important symposia have been held in Belgium, the first on power reactors at Mol during November 1956, and the second in Brussels on reactor fuel element reprocessing in May 1957. A depository library was given to CEN in June 1955.

In addition, the Commission has provided a depository library to the Lovanium University in the Belgian Congo, and transferred the necessary enriched uranium to fuel a TRIGA-type reactor, which went into operation in Leopoldville in 1959. This was the first reactor to achieve criticality in Africa.

The headquarters of the European Community for Atomic Energy (EURATOM), of which Belgium is a member, is in Brussels. The United States and EURATOM signed on November 8, 1958, an Agreement for Cooperation establishing a joint program for the construction of large-scale power reactors. In implementing this program, the AEC has assigned a staff to Brussels to work closely with the EURATOM officials.

Belgium

Belgium's tentative nuclear power goals, as of July 1, 1959, were to install 300 megawatts by 1963, 500 megawatts by 1967, and 1500 megawatts by 1975. Under the U.S.-EURATOM Joint Program, the Belgians are considering, in cooperation with France, the construction of a large-scale power reactor of U.S. design, to be in operation by 1965.

UNITED KINGDOM

Under the U.S.-U.K. Agreement for Cooperation concerning civil uses of atomic energy, there has been a continuous and close collaboration in the exchange of information in a variety of fields. Substantial classified information has been exchanged to supplement the unclassified exchanges. Specific areas of information exchange include the following:

Calder Hall Reactor Exchange

Detailed technological information on the Calder Hall gas-cooled power reactors has been received from the U.K., pursuant to an agreement reached in June 1957. In June 1958, the agreement was extended to include detailed fuel element technology. Under this arrangement, the U.K. has provided all design and operating data on the Calder Hall reactors, including fabrication data and irradiation performance of the fuel elements. Additional useful information has been derived through exchange of data on materials, particularly on graphite, uranium and uranium dioxide, and beryllium.

Fast Neutron Reactor Exchange

In February 1956, the U.S. and the U.K. agreed to exchange detailed technological information on experimental fast neutron breeder reactors. In this agreement, the U.S. provided detailed information on EBR-I, EBR-II and ZPR-III in exchange for similar information on the U.K. reactors, ZEUS, ZEPHYR and DOUNREAY. The fact that the British DOUNREAY reactor involves a design that is

United Kingdom

different from, and complementary to, designs in the U. S., has contributed to the usefulness of the exchange. Of special interest is the theoretical work of the U. K. on our EBR-I, and the observance of loading operations at DOUNREAY by two U. S. engineers.

Controlled Fusion Power

Since September 1956, information on controlled thermonuclear reactions has been exchanged with the United Kingdom. The British pilot scale machine, ZETA, became operative in August 1957, and important information has come to the United States from this work. Information on the four methods of gaining fusion power, as pursued by the United States, has been communicated to the United Kingdom. Although initiated as a classified exchange, this work has since been completely declassified. Since its inception, the exchange has been extensive and extremely effective, involving frequent conferences and visits in addition to document transmission.

Reactor Safety

Reactor safety is an area where the broadest and most expeditious exchange is promoted by both parties. Some outstanding events of the past several years include the joint U. S.-U. K. meeting on Reactor Safety in Chicago in June 1956, where a great deal of new and useful information was communicated on both sides. The unfortunate accident at the Windscale Pile No. 1 in the U. K. in October 1957 led to much additional attention to safety problems, with experts on both sides studying the problem of annealing the

United Kingdom

stored energy in graphite-moderated reactors. As a follow-up, the U.S. sent observers to Harwell in March 1958 to witness annealing of the BEPO reactor, and gained information of importance to the safe release of energy in our own ORNL X-10 reactor. Accident information is communicated promptly to avoid additional occurrences and to plan jointly preventive measures.

Chemical Reprocessing

Communication of data on the chemical recovery of irradiated reactor fuel has taken place from the start of the U.S.-U.K. cooperative exchange. However, this cooperation was given added impetus and acceleration by reason of the design of a new separation plant, to be located at Windscale, to handle fuel elements from the civilian power stations now under construction in the U.K. In the furtherance of cooperation in this area, a delegation from the U.K. Atomic Energy Authority met with AEC experts at the Savannah River processing plant in May 1959 to discuss design features of separations plants, and, especially, factors important to the Windscale plant design. An AEC delegation, in turn, visited the U.K. in November 1959 to continue the exchange. Meanwhile, the AEC conducted a Symposium on the Chemical Processing of Irradiated Fuels at Richland, Washington, in October 1959, attended by UKAEA representatives, among others.

United Kingdom

Basic Research and Development

During the Geneva Conference of 1958, Dr. W. F. Libby, then a Commissioner, and Sir John Cockroft, UKAEA, reached agreement on means of speeding U. S.-U. K. cooperation in basic research and development. Specific areas of cooperation were selected and experts designated by each Government to establish closer collaboration in the following fields: (1) basic research in general and controlled thermonuclear reactions, (2) uranium oxide fuels, (3) gas coolant compatibility, (4) beryllium, and (5) plutonium recycle research.

Joint conferences were held on controlled thermonuclear reactions at Berkeley, California, in April 1959; on beryllium at Nuclear Metals, Inc., Cambridge, Massachusetts, in May 1959; on plutonium recycling at Argonne National Laboratory, in June 1959; on uranium oxide fuels at Harwell, in June 1959; and on gas coolant compatibility at Oak Ridge National Laboratory, in February 1960. Three additional joint meetings have already been scheduled in 1960 in the furtherance of the exchanges.

Chemistry

In addition to the communication of chemical information through document exchanges, a program of exchanging chemistry staff members between Argonne National Laboratory and Harwell has existed since October 1956. To date, four Harwell scientists and five Argonne scientists have been granted extended assignments to enable them to participate in this program.

United Kingdom

In recent studies the Argonne 60" cyclotron has been used to investigate irradiation effects on water, particularly the gamma radiolysis of water. Studies of short-lived, fission-produced isotopes of rhodium and niobium have been undertaken to identify nuclides created by fission, and to determine nuclear properties and yields. Substantial work has been performed on radiation chemistry and on chemical behavior of ruthenium in separations processes.

There is excellent communication between the laboratories in this area, and one major outcome of the program has been the discovery of element 102 (nobelium) at Stockholm in 1957, resulting from a cooperative study among scientists of ANL, Harwell, and the Nobel Institute.

Advanced Gas-Cooled Reactors

In November 1959, the U.S. and U.K. reached an agreement to exchange information on the development, design, construction, and operation of the U.K. Windscale Advanced Gas-Cooled Reactor (AGR) and HERO for the same information on the U.S. Experimental Gas-Cooled Reactor (EGCR). The information received by the U.S. and the U.K. under the Agreement may be provided to British and American industry for normal commercial use.

The U.S. and the U.K. have appointed coordinators to assure that information is collected and transmitted expeditiously. The exchange was initially implemented in January 1960 and is now active.

United Kingdom

Meetings are planned in both countries to obtain data first-hand by inspection of facilities and direct discussions with scientists and engineers at the working level.

High-Temperature Gas-Cooled Reactors

A European research program on high temperature gas cooled reactors, known as the DRAGON project, has been established at the U.K. facility at Winfrith Heath under the auspices of the OEEC European Nuclear Energy Agency. Participants from the OEEC member countries who have agreed to this joint program are: the U.K. Atomic Energy Authority, Austria, the Danish Atomic Energy Commission, the EURATOM Commission, the Norwegian Institutt for Atomenergi, the Swedish Company A. B. Atomenergi, and Switzerland. The main element in the DRAGON project agreement is the construction and operation of a 10 MW (thermal) power reactor, to be located at the UKAEA establishment at Winfrith Heath. The total cost of the DRAGON project, including the construction of the reactor, is estimated at approximately $35,000,000. The reactor is due to be completed by 1962. Under the provisions of the DRAGON project agreement, the U.K. Atomic Energy Authority may, with the approval of the DRAGON Board of Management, enter into an arrangement with another country to exchange information on high temperature gas cooled reactors.

United Kingdom

The USAEC submitted a proposal to the U.K. Atomic Energy Authority for collaboration on high temperature gas cooled reactors, and this proposal was accepted by the DRAGON project Board of Management in February 1960.

The agreement provides for the exchange of detailed information on the DRAGON reactor to be constructed at the UKAEA establishment at Winfrith Heath and the 40 MWE high temperature gas cooled reactor to be constructed in the United States, based on the proposal submitted to the AEC by the Philadelphia Electric Company and General Atomics.

Under the proposed agreement, the DRAGON participants will make available to the AEC unclassified information developed under the DRAGON program, including the details of design, construction and operation of the DRAGON reactor and the results of the supporting research and development work financed from DRAGON funds. The AEC will make available to the DRAGON project all unclassified information developed for the AEC under its contract with Philadelphia Electric Company for the design, construction and operation of a 40 MWE advanced high temperature, graphite moderated, helium cooled nuclear power reactor, as well as its contract with General Atomics for the research and development in support of this reactor.

The information received by the AEC and the AEA under this proposed agreement may be made available to industry in the United States and DRAGON signatory countries for normal commercial use.

United Kingdom

Enriched Fuel for Research Reactors

Although the United Kingdom has other sources for acquiring uranium, and possesses its own enrichment facilities, the USAEC, in order to meet the requirements for enriched fuel for a limited number of research reactors of U.S. design to be built and operated in the United Kingdom in cooperation with U.S. firms, proposes to make available to the UKAEA under Article III-A of the present bilateral agreement such fuel as is necessary to meet these specific needs.

CANADA

On July 21, 1955, the U.S. entered into a comprehensive research and power agreement for cooperation in the peaceful uses of atomic energy with Canada. This Agreement was subsequently amended on March 4, 1957, to provide for expanded cooperation. Under this Agreement the primary area of interest and cooperative effort has been the development of heavy water power reactors.

Within the framework of this Agreement, the two countries have developed an extremely close and effective working relationship in a number of areas of activity of mutual interest. In June 1957 a formal program was established under our Agreement for Cooperation with Canada to provide close cooperation between USAEC and AECL on the development, design, construction, operation, use and maintenance of pressurized and boiling heavy water moderated power reactors. That program provides for the continuing exchange of information through visits, reports, exchange of personnel, and the reciprocal use of facilities, equipment and materials, including enriched materials.

In April 1959 the program was expanded to establish cooperation with respect to reactor components and "hardware" for the Hanford New Production Reactor (NPR) and the Canadian Nuclear Power Demonstration (NPD-2) Reactor. While involving the NPR, neither this exchange of information nor the original agreement includes any restricted data that is primarily of military significance.

Canada

The principal U. S. organizations currently involved in the program for cooperation are AEC, Savannah River Laboratory (operated by the du Pont Company), Hanford Works (operated by the General Electric Company), Argonne National Laboratory, Atomics International (Division of North American Aviation). Canada is represented by AECL, the Canadian General Electric Company and the Hydro Electric Power Commission of Ontario.

The program of cooperation has been of mutual benefit in the advancement of heavy water moderated reactor technology, principally through the expeditious exchange of detailed technical information between the AEC and AECL. Technical reports by each organization are provided to and distributed by the other. Periodic meetings between personnel of the Canadian and U. S. organizations involved are held to permit comprehensive discussions of technical information, advance new ideas and plan future programs.

To assure a continuing flow of technical information on a timely basis, and to provide for maximum integration of Canadian and U. S. reactor technology, scientists and engineers from the contractors and laboratories of AEC and AECL have been assigned to the facilities of the other for periods of one year or more.

The AEC has assigned three scientist-engineers to AECL, representing Argonne National Laboratory, du Pont, and Atomics International. These men are specialists, respectively, in boiling water reactors, heavy water natural uranium reactors and organic moderated reactors. In addition, the staff of the U. S. Atomic Energy Liaison Office (Chalk

54953 O—60—vol. 2——26

Canada

River) was supplemented in December 1959 by assignment of an AEC engineer to Toronto to implement the existing cooperative effort on NPD-2 and CANDU and the AEC heavy water reactor program. The AECL has, as part of this personnel exchange, assigned an engineer to du Pont (Wilmington) for the purpose of following research and development on the U. S. heavy water power reactor program,and, particularly, the HWCTR. Also, AECL has assigned an engineer to Argonne National Laboratory to establish technical liaison on boiling water reactor technology. Previously two AECL engineers spent a year at ANL on heavy water reactor technology.

In addition to the exchange of information carried out by these means, irradiation services and test loop space have been made available for experiments of mutual interest.

The success of the established program for cooperation and the status of their respective efforts in the development of heavy water moderated power reactors has led to recent discussions between AECL and AEC regarding the possibility of rendering further assistance to each other through more intensive and integrated cooperative efforts. It is hoped that this further expansion of Canadian-U.S. cooperation will soon be effected so that our historic and fruitful relationship in the field of atomic energy will continue to bestow its benefits upon both parties.

In addition to the exclusively bilateral effort described above, several other activities of mutual interest have been undertaken on a tripartite basis with Canada and the United Kingdom. These are:

Canada

1. Cooperation in Hot Loop Studies

   Information has been exchanged among the three countries on reactor materials and media from the standpoint of corrosion, heat transfer, high-temperature strength, resistance to radiation, etc.

2. Exchange of Nuclear Cross-Section Data

   A Tripartite Nuclear Cross Sections Committee was established in early 1956 to maintain close liaison among the respective national efforts in the field of nuclear cross-section measurements and basic nuclear data generally relevant to atomic energy programs.

3. Establishment of Information Centers on Reactor Physics Constants

   Centers have been established at Argonne National Laboratory and Harwell for coordinating information developed abroad, and they serve as clearing houses for exchange of data useful in reactor core design.

4. A number of Tripartite Conferences with Canada and the U. K. have been held for the detailed exchange of instrumentation information, and there has been extensive information exchange concerning fallout from nuclear detonations.

Since January 1, 1957, the U. S. has made 3,555 shipments of various isotopes to Canada. In the area of special nuclear materials and reactor materials the U. S. has leased significant quantities of normal uranium and heavy water and sold smaller quantities of a variety of other materials. (See attached table for full description of all materials transactions.)

Canada

Under the Agreement, the U. S. has donated two technical libraries, one located at McMaster University in Hamilton, Ontario, and the other at the University of British Columbia in Vancouver. A vast number of Canadian technical and administrative personnel have visited AEC laboratories and offices throughout the country to discuss topics of mutual interest and observe our various projects.

Canada

	Res. Purposes		Reactor Fuel		Other	
	Lease	Sale	Lease	Sale	Lease	Sale
Contained U-235 - (kg)						
UO_2 (20%)		4.325				
UO_2 (7.0%		5.606				
NBS Standards (12.60%)						0.001
Total		9.931				0.001
10 MG						
NRX Reactor (90%)			11.216			
Foil (Gift) (90%)						0.009
U Alloy - NRX (90%)	4.766					
Fuel Elements (90%)			3.438			
UO_2 (90%)		1.024				
Metal (90%)		0.300				
Foil (90%)		0.025				
Burn-up of Lease Mat'l				1.595		
NBS Standards (84%)						0.002
McMaster U Res. Reactor (1MW) Fuel Elements (90%)			5.935			
Fiss. Counters (90%)						0.003
Total	4.766	1.349	20.589	1.595		0.014

Canada Con't - Next Page

Canada (Con't)

	Res. Purposes		Reactor Fuel		Other	
	Lease	Sale	Lease	Sale	Lease	Sale
Normal Uranium (kg)						
Misc.		222				
Depleted Uranium (kg)						
NBS Standard						0.001
U_3O_8 (Lean)						0.020
Total						0.021
Plutonium - GI						
Metal (Exchange)						2.00
Oxide (Gift)						0.05
Total						2.05
Heavy Water (Lbs)						
For NRX NRU Reactors		232,634.0				
For U. of Toronto		6,986.0				
Total		239,620.0				

DENMARK

Already possessing a notably well-respected scientific community, the Danish Government in March 1955 laid the basis for the development of an active atomic energy program with the creation of an Atomic Energy Commission. The Commission's nuclear research program resulted in the establishment of a national nuclear research center and the acquisition of necessary equipment to effectively operate the center.

A "research" Agreement for Cooperation with the United States was signed on July 25, 1955, to assist the Danish Government in carrying out the initial phase of its program. Subsequent amendments increased the quantities of reactor fuel that could be transferred from 6 to a net amount of 50 kilograms of contained U-235 enriched up to 20% including a provision for transferring up to 90% enriched U-235 for use in research and materials testing reactors each capable of operating with a fuel load not in excess of 8 kgs, and permitted the transfer of research quantities of special nuclear material for defined research projects.

The national research center was established at Riso and two research reactors, the DR-1 and DR-2, were purchased from the United States. The DR-1, a water boiler reactor of 500 watts thermal power, went critical in August 1957 and is being used for reactor training and physical experiments. The DR-2, a tank-type research reactor of 5 megawatts thermal power, with a neutron flux of $5 \times 10^{13} n/cm^2/sec$, went critical in December 1958 and is being used for training purposes,

Denmark

neutron exposure experiments, and isotope production.

The United States gave Denmark a financial grant of $350,000 toward the cost of construction of the DR-2 reactor under its reactor grant program. In addition to Riso, the ISOTOPCENTRALEN, an organization of the Danish Academy of Technical Sciences interested in the promotion and utilization of isotopes, and DANATOM, an industrial grouping of Danish firms studying atomic energy for merchant ships and central station power, are expected to contribute significantly to the Danish nuclear program.

Additional assistance has been provided Denmark by the United States through the training of 18 Danish scientific and technical personnel at facilities of the United States, either on individual assignments or as participants in courses sponsored by the Atomic Energy Commission. In addition, about 42 Danes have visited AEC facilities. A technical library has also been presented to Denmark.

FRANCE

France has the largest atomic energy program in continental Europe outside of the Soviet Union. Since 1945, the Commissariat a l'Energie Atomique has been charged with responsibility for developing the uses of atomic energy in France. On June 19, 1956, the United States and France signed an agreement providing for the transfer of up to 40 kilograms of enriched uranium to France. On July 3, 1957, this Agreement was amended to permit the transfer of up to 2500 kilograms of enriched uranium.

The first French reactor, a natural uranium, heavy water moderated, research reactor, designed and built by the Commissariat, went into operation in 1948. The Commission has provided slightly enriched uranium and heavy water for the French-designed and -built high-flux reactor, EL-3, located at Saclay, and under the terms of the Agreement for Cooperation the Commission has furnished or will provide enriched uranium for seven other research and test reactors and reactor experiments which the French have built or are building in their program.

Since January 1, 1955, 408 French visitors have been received at Atomic Energy Commission facilities and 104 French scientists and engineers have been trained in Commission schools or in specialized individual training programs in Commission facilities. Two depository libraries have been given to France, one of which is located in Paris

France

and the other at the main French installation at Saclay, about 20 miles southwest of Paris. In November of 1957, the AEC and CEA jointly sponsored a fuel element conference in Paris.

As reported in Geneva Paper No. 131, the tentative goals of the French nuclear power program call for 850 megawatts by 1965, 8,000 by 1975 (representing 30% of total electricity produced). The first generation of power reactors will all be of the natural uranium, graphite-moderated, gas-cooled type and of progressively larger size. For the second generation, the CEA plans to concentrate on two reactor types: heavy-water-moderated, gas-cooled reactors, and fast reactors. Detailed technical exchange on fast reactors, including the assignment of AEC personnel in France and CEA personnel in Commission facilities, has been under way since the end of 1959. Exchange of information on heavy-water-moderated, gas-cooled reactors is beginning. Within the terms of the U.S.-Euratom Agreement for Cooperation, signed November 8, 1958, relating to the joint program, the French, in cooperation with the Belgians, have indicated an interest in building a 150 megawatt power station of U.S. design in the Ardennes.

An AEC scientific representative has been attached to the United States Embassy, Paris, since late 1956, to provide continuous liaison on technical matters with the French Atomic Energy program.

GERMANY

For ten years following the War, nuclear research and development was not permitted in Germany. With the lifting of allied prohibitions in 1955, the German Government established a Ministry for Atomic Affairs and, on February 13, 1956, a research agreement was signed with the United States. An amendment to this agreement raising the maximum amount of fuel that could be provided from 6 to 12 kilograms was signed on June 29, 1956, in order to provide fuel for three research reactors for which, in the brief intervening period, the German Government had developed firm plans. The research agreement was superseded by a comprehensive agreement signed July 3, 1957, and providing for the transfer of 2500 kilograms of enriched uranium.

Germany's first research reactor, a one megawatt swimming pool, was constructed by an American contractor, (AMF Atomics) and fueled with 20% enriched material received from the United States. The reactor was the first to go critical in either East or West Germany in October 1957. In January 1958, a 50 kilowatt water boiler went into operation in Frankfurt, and in October of the same year a 5 megawatt pool type reactor went critical in Hamburg. Both reactors were obtained from the United States (one from Atomics International and the other from Babcock and Wilcox) and are fueled with U. S. enriched uranium. On May 27, 1958, the United States committed $350,000 as a research reactor grant to the German Government for the

Germany

Munich reactor. Hazards evaluation information assistance has been provided for the research reactors at Frankfurt and Munich, for two proposed power demonstration reactors and one proposed large scale power reactor to be built in Germany. Two German companies are building Argonaut type reactors for which enriched fuel is to be provided under the Agreement for Cooperation.

Germany's Atomic Power program as described in Geneva Paper No. 1806 calls for the installation of 500 megawatts by 1965 and 6000 megawatts by 1975. A United States firm is presently constructing a 15 megawatt boiling water power demonstration reactor at Kahl to be completed during 1960. Under the terms of the United States-Euratom joint program another United States firm is negotiating the construction of a 150 megawatt power reactor. The German nuclear propulsion program centered at Hamburg and currently utilizing the swimming pool reactor there, is considering the installation of an organic moderated reactor of U.S. design on a German tanker.

Since January 1, 1955, 421 German visitors have been received at AEC facilities and 246 German scientists and engineers have been trained in Commission schools or in individual assignments at AEC facilities. A U.S. Atoms for Peace library was given to Germany in January 1957 and is located in Munich. A second library collection has been made available to the Gmelin Institute in Frankfurt.

In addition to the cooperative arrangements with the German Government, bilaterally and through Euratom, a separate research

Germany

agreement for Berlin was signed on June 28, 1957. A 50 kilowatt water boiler research reactor designed and constructed by an American firm (Atomics International) went into operation there in July 1958. The Commission has assisted the Hahn-Meitner Institute in Berlin, where the reactor is located, by making available a reactor physicist to assist in the supervision and operation of the reactor and in the experimental program. A U.S. Atoms for Peace library has also been given to Berlin.

ITALY

Italy has long been recognized as one of the nations of Western Europe where nuclear power will first become competitive, largely as a result of the high cost of fossil fuel fired stations in some of its major power consuming areas. On June 26, 1952, the Italian National Committee for Research (CNRN) was established as the responsible body within the Italian Government for research and coordination of nuclear affairs. On July 28, 1955, the United States and Italy signed a research agreement for cooperation which was superseded by a comprehensive agreement signed on July 3, 1957. The comprehensive agreement provides for the transfer (over a 20 year period) of 7000 kilograms of enriched uranium, the largest net amount authorized in any Agreement for Cooperation with an individual nation.

Five research reactors, all of American design, have been built or are under construction in Italy and are fueled with enriched material received from the United States. On February 3, 1958, the United States obligated $350,000 as a research reactor grant to Italy for a CP-5 type swimming pool heavy water machine, located in the principal Italian nuclear center in Ispra some 40 miles north of Milan. Since January 1, 1955, a total of 184 Italian visitors have been received in AEC facilities in addition to 159 scientists and engineers trained in Commission schools or on specialized assignments in AEC facilities. The Commission has provided a consultant physicist for short-term dis-

Italy

cussions at Ispra on solid state physics. In addition, advice and assistance on reactor hazards evaluation has been given for reactors at Ispra, Milan and in connection with the SENN power project.

A U.S. Atoms for Peace library was presented to Italy on March 30, 1955, and is located at Rome. An additional library collection has been provided to the CNRN for Milan and Ispra. The AEC has provided the CNRN's Rome Nuclear Center with a Co-60 agricultural irradiation facility. As indicated in Geneva Paper No. 1363, Italy's tentative nuclear power program provided for 320 megawatts by 1962, 650 by 1963, and 900 by 1965. At present three large scale power reactors are under construction: one a pressurized water reactor designed by Westinghouse for SELNI (Societa Elettronucleare Italiana) and to be fueled under the U.S.-Italian bilateral; the second a boiling water reactor to be designed by General Electric for the SENN group and to be fueled under the U.S.-Euratom joint program; the third project is a natural uranium Calder Hall type reactor to be constructed under the cooperative agreement between Italy and the United Kingdom. Italy, as a member state of Euratom, participates fully in the Agreement for Cooperation, signed November 8, 1958, between the United States and Euratom establishing the joint program.

THE NETHERLANDS

The Reactor Centrum Nederland (RCN) established in July 1955 has the principal responsibility in The Netherlands for coordinating research and development in reactor technology. On July 18, 1955, the United States and The Netherlands signed a research reactor Agreement for Cooperation. A superseding comprehensive agreement, signed July 22, 1956, and an amendment signed July 3, 1957, became effective on August 8, 1957, and permitted transfer of up to 500 kilograms of U-235 for use in research, test and power reactors in The Netherlands. A further amendment signed July 22, 1959, conformed the fuel article of the Dutch bilateral with those of her Euratom partners and authorized Dutch use of highly enriched material in research reactors and reactor experiments as well (as had been previously provided) in materials testing reactors.

The United States has provided 20% enriched uranium to The Netherlands for fueling a 100 kilowatt swimming pool research and training reactor of U.S. manufacture which was originally exhibited and operated at the Amsterdam Fair in 1957 and is now installed at the Technical University at Delft. A 20 megawatt pool-type, high flux MTR reactor of U.S. manufacture, is nearing completion at the Dutch National Laboratory near Petten on the NorthSea, 30 miles from Amsterdam. In addition to fuel for the Petten and Delft reactors, the Atomic Energy Commission is providing fuel for an Argonaut research

The Netherlands

reactor scheduled for completion in late 1960 at Petten, and has leased 2500 kilograms of natural uranium for use in a sub-critical assembly at the University of Delft.

In June 1956 the United States obligated $350,000 as a research reactor grant toward the cost of the Petten high flux reactor and has provided advisory assistance to The Netherlands Government on any potential hazards associated with this kind of project. Since January 1, 1955, 95 Dutch visitors have been received in AEC installations and 71 scientists and engineers have been trained in AEC schools or on specialized assignments in AEC facilities. In September 1955 a U.S. Atoms for Peace depository library was given to The Netherlands and is located at the RCN in The Hague.

Tentative goals of the Dutch nuclear power program as expressed in Geneva Paper No. 2435 are 400 megawatts by 1965, 1200 megawatts by 1970, and 3000 megawatts by 1975. In the text, The Netherlands Government has indicated that by 1975, 50% of electricity would be generated by nuclear power representing 15% of the total national energy consumption. The Netherlands provincial power companies have been studying power reactors of United States design with the view to the installation of a large scale reactor probably to be fueled under the U.S.-Euratom joint program. In addition, two Dutch groups are studying pressurized water reactors for installation in tankers. The RCN has pursued a research and development program on homogeneous reactor systems maintaining through periodic visits close association with the U.S. work at Oak Ridge.

54953 O—60—vol. 2——27

JAPAN

Japan, the most industrialized country in the Far East, formulated its atomic energy program in 1955, with immediate emphasis on training, research and radioisotope application and with a long-range objective of utilizing atomic power and the development of supporting industries. Both the Government of Japan and Japanese private industry and universities are extensively committed to the development of atomic energy for peaceful purposes. In 1956, the Government of Japan established an Atomic Energy Commission to advise the Prime Minister and to establish policy in the field. An Atomic Energy Bureau in the Science and Technics Agency was also established at that time to administer the Japanese program. Other key organizations formed were the National Institute for Radiological Science, the Japan Atomic Fuel Corporation, the Japan Atomic Power Company, and the Japan Atomic Energy Research Institute. In addition, several private firms have pooled their efforts and have commenced research and development in various phases of atomic energy application. The manufacture of atomic energy instruments and equipment is becoming an increasingly important activity.

On November 14, 1955, the United States and Japan signed a research Agreement for Cooperation, which, on December 5, 1958, was superseded by a comprehensive agreement providing for the transfer of 2,700 kgs. of enriched uranium.

Japan

Japan's first research reactor, a 50 Kw "water boiler" was constructed by an American contractor at the Japan Atomic Energy Research Institute (about 75 miles northeast of Tokyo), and fueled with 20% enriched material received from the United States. This reactor was the first to go critical in the Far East and has been in operation since August 1957.

A second research reactor, a 10 Mw CP-5 type, is under construction by an American contractor at JAERI and will be fueled with 20% enriched uranium and moderated by heavy water obtained from the United States. The United States has committed a $350,000 research reactor grant to Japan for this reactor, which is expected to go critical in the spring of 1960.

Hazards evaluation information and assistance has also been provided Japan for the two research reactors. Several Japanese universities are considering the procurement of research reactors. A TRIGA-type reactor is under construction by an American firm for installation at Rikkyo University, and will be fueled with enriched uranium obtained from the United States.

Japan's tentative atomic power goals are 300 eMW by 1965 and 2,000 eMW by 1970. A contract is presently under negotiation between the Japan Atomic Energy Research Institute and an American firm for the construction of a 12 eMW boiling water demonstration power reactor for operation by 1961. It is understood Japan also is considering the installation of about 250-300 eMW of enriched-uranium-fueled reactors in the future.

Japan

The Japan Atomic Power Co., signed a contract with a British firm in December 1959 for a 150 eMW Calder Hall-type power reactor which is scheduled for completion in 1964.

In further support of Japan's program, about 260 technical and scientific personnel have received atomic energy training in the United States. Over 880 additional Japanese have visited AEC facilities, including many of the key government, industrial, and university leaders in the atomic energy field. A technical library has also been presented to Japan.

An AEC Scientific Representative has been attached to the United States Embassy, Tokyo, since November 1958, to provide continuous liaison on technical matters with the Japanese atomic energy program and with other countries' programs in the area. A number of Commission and Commission contractor personnel have visited Japan to participate in various technical and scientific conferences and to consult on atomic energy matters.

SWITZERLAND

The atomic energy program of Switzerland was first established in 1955 with the creation of a private corporation known as Reaktor, A.G., comprising over 100 Swiss firms and responsible for planning and administering a nuclear research and development program. Among its early plans were the training of personnel, establishment of a national laboratory, acquisition of necessary equipment, and investigation of the prospects of nuclear power for the country.

A research Agreement for Cooperation was signed in July 1955 with the United States, providing for the purchase of the U. S. Government's swimming pool exhibit reactor and transfer of necessary fuel and information therefor, following conclusion of the Geneva Conference in August 1955. The reactor was subsequently transferred to Wuerenlingen, which became the site of the Swiss national laboratory, where it is being used for training, research, and isotopes production.

In June 1956, a classified Agreement for Cooperation, providing for the exchange of Restricted Data relating to power reactors and for the transfer of necessary fuel for a number of small power reactors, was signed with the United States. As and when the results of these power reactor experiments were determined, plans for large-scale nuclear power stations would be discussed.

Several Swiss universities became interested in acquiring research reactors in 1958. The University of Basel purchased an AGN-211 research and training reactor from a U. S. firm, which formed part of the U. S.

Government's exhibit at the Brussels Exhibition in 1958. Following the second Geneva Conference in September 1958, the University of Geneva purchased an AGN-201 research and training reactor, which was exhibited by the U. S. Government during the Conference. In addition, universities at Zurich and Lausanne have indicated an interest in acquiring small training reactors. The acquisition of such reactors, used in conjunction with the work at the Wuerenlingen laboratory, may be expected to enhance considerably atomic energy training and research in Switzerland.

Further assistance was provided to the Swiss Government by the training of 29 Swiss nationals in U.S. facilities and other exchanges of information with 54 Swiss visitors to U.S. atomic energy installations.

BRAZIL

Early atomic energy relations between Brazil and the U.S. beginning in 1945 and continuing through 1955 were limited to contracts for the purchase by the U.S. of monazite sands, rare earths, and thorium and to uranium exploration assistance. Additional U.S. - Brazil atomic energy cooperation commenced in 1955 when the Brazilian Minister of Foreign Relations invited representatives of the USAEC to visit Brazil to discuss collaboration in the field of atomic energy. Following this a research Agreement for Cooperation and a joint uranium exploration agreement were signed with Brazil in August 1955 in Rio de Janeiro. The research agreement permitted the U.S. to furnish enriched material to fuel a 5 megawatt pool type research reactor manufactured by an American firm and located at the University of San Paulo. Pursuant to the President's reactor grant program, $350,000 was contributed by the U.S. toward the purchase of this reactor when it was dedicated in January 1957. The U.S., at Brazil's request, amended this research agreement to increase from 6 to 15 kilograms the amount of fuel which could be made available to Brazil. This additional fuel is to be used for a TRIGA reactor which has been constructed by an American firm at the University of Bello Horizante. Brazil also plans to install an Argonaut type reactor at the University of Brazil in Rio de Janeiro which will be fueled with enriched uranium to be supplied by the U.S. The U.S., under its equipment grant program, has furnished the Aeronautical Technical Institute at San Jose dos Campos a subcritical assembly, including the natural uranium fuel, which will be used in connection with nuclear training and research courses at that Institute.

A power Agreement for Cooperation has been signed and when effective, will permit the U.S. to furnish 550 kilograms of enriched uranium for fuel for an experimental boiling water type power reactor of 12,500 kilowatts and a materials testing reactor which the Brazilians have informed us they plan to build.

In assisting Brazil develop this nuclear program, the United States has trained 48 students in disciplines related to nuclear energy; furnished the services of consultants in the fields of health physics and radiochemistry; donated a technical library to Brazil; sent an Atoms for Peace Mission to Brazil to meet with Brazilian scientists and consult with them on the needs and future courses of their programs; has provided Brazil with advice concerning the way to assess any hazards associated with locating and operating research reactors; and furnished extensive advice and assistance to Brazil under a raw materials exploration agreement. Forty-three Brazilians have also visited AEC facilities.

ARGENTINA

The Argentine National Atomic Energy Program is fully organized with an active atomic energy organization operating at a permanent headquarters building which includes administrative offices, laboratories, and special equipment. Emphasis in the Argentine program has been placed on uranium ore exploration and processing, training and research.

Relatively high grade uranium ore has been discovered in several areas of Argentina and uranium ore processing and refining plants capable of processing several hundred tons of ore daily are in operation.

Research is being carried out on irradiation of various chemicals, thermal diffusion of enriched isotopes, production of heavy water, processing uranium concentrates and fuel reprocessing, extraction of uranium from its ores, methods of manufacturing fuel elements with metallic uranium and with uranium oxides, and effects of irradiation on fruit flies and laboratory animals.

In the field of training, the following has been initiated in the country: a three-year course in nuclear and solid state physics at the Institute of Physics at Bariloche; a five-weeks radioisotope utilization course at the Argentine Commission headquarters; a radioisotopes course at the University of Buenos Aires Medical School; short courses in the principles of reactor engineering by the University

Argentina

of Buenos Aires; and a one year course in metallurgy at the Argentine Commission headquarters. Close cooperation between the Argentine Commission and the U.S. Atomic Energy Commission has been achieved in the above exploration, research, and training programs.

Under a research Agreement for Cooperation which entered into force on July 29, 1955, the United States has furnished Argentina with uranium enriched to 20% U-235 to fuel an Argonaut type reactor which was constructed by the staff of the Argentine Commission. Pursuant to the atoms for peace equipment grant program, the United States has made grants to the Argentine Government of a Co-60 agricultural unit, a Co-60 teletherapy unit, and a medical radioisotopes laboratory. In addition, two teams of scientific specialists from the United States have visited Argentina to assist the Argentine in formulating their program. A U.S. Atomic Energy Commission Scientific Representative was assigned to the U.S. Embassy Buenos Aires in November of 1957 to provide continuous liaison on technical matters with the Argentine and other Latin American atomic energy programs.

The United States also has assisted Argentina by training 36 Argentine nationals in various disciplines related to nuclear energy and has furnished the services of five consultants in the fields of health physics and radiation biology. Sixty-two Argentinians, in turn, have visited AEC facilities. The United States has donated a technical library to the Argentine Government.

ISRAEL

Israel is developing an extensive program of training and research in the field of atomic energy, with a 1-5 megawatt pool-type reactor planned as the primary facility of a Nuclear Center near Rehovoth. The Nuclear Center will also contain supporting laboratory facilities dealing with experimental and applied aspects of nuclear energy. Under the terms of a 1955 research Agreement for Cooperation with Israel, as amended, the United States has recently transferred to the Israeli AEC 6.5 kilograms of uranium enriched up to 90% for use as fuel in the research reactor which is being constructed for the Israeli AEC by the American Machine and Foundry Company and is expected to go critical in April 1960. The United States has made a $350,000 grant commitment for the reactor. In addition to leasing reactor fuel, the United States has also sold to Israel fission counters, plutonium-beryllium neutron sources, and a slow neutron chopper for use in the reactor project.

Approximately 56 Israelis have received training in the field of atomic energy in United States facilities, either on individual assignments or as participants in courses sponsored by the Atomic Energy Commission. An additional 24 Israelis have visited AEC facilities.

The U.S. AEC has also provided hazards evaluation information to Israel in connection with the Israeli research reactor and has furnished consultant service with respect to the plans of the Israeli AEC for a hot laboratory.

A technical library has been presented to Israel by the United States.

REPUBLIC OF CHINA

The Republic of China's atomic energy program is presently centered around the training of personnel, research, and isotope applications. To achieve this objective, an Institute of Nuclear Science was established in 1956 at the National Tsing Hua University of Hsinchu. The Institute has a 3 MEV Van de Graaff accelerator in operation, and a 1 MW pool-type research reactor is presently under construction there by an American contractor. The reactor, which is expected to commence operation in the summer or fall of 1960, will be fueled with enriched uranium obtained under an Agreement for Cooperation which has been in effect since July 18, 1955. The U.S. has committed a research reactor grant in the amount of $350,000 for the reactor, and has also provided hazards evaluation information in connection with its siting and operation. A grant of approximately $91,000 has also been made by the U.S. to China for a radioisotope laboratory and nuclear engineering equipment.

Approximately 155 Chinese have received training in the field of atomic energy in United States facilities, either on individual assignments or as participants in courses sponsored by the Atomic Energy Commission. An additional 64 Chinese have visited AEC facilities.

A technical library has been presented to China by the United States.

The AEC Scientific Representative in Tokyo has visited Taiwan several times to consult and advise on China's atomic energy plans. In addition, the U.S. has furnished short-term consultants to China for assistance in planning its program.

THAILAND

Thailand's atomic energy plans are presently centered on the training of personnel and the installation of a research reactor. A 1 MW pool-type research reactor is under construction by an American contractor. A research Agreement for Cooperation with Thailand came into effect on March 13, 1956, and was amended by an agreement signed March 27, 1957. A second amendment is presently under negotiation to provide for 90% enriched uranium for use as fuel in the proposed 1 MW research reactor which is expected to become operational in the latter half of 1960. The U. S. has committed a $350,000 research reactor grant to Thailand for the reactor.

In support of the Thai's program, about 45 technical and scientific personnel have received in the field of atomic energy, either on individual assignments or as participants in courses, training sponsored by the AEC. Over 42 additional Thais have visited AEC facilities. A technical library has been presented to Thailand, as has a cobalt-60 teletherapy unit.

The AEC Scientific Representative in Tokyo has visited Thailand to consult and advise on Thailand's atomic energy plans. The U. S. has also furnished short-term consultants to Thailand for assistance in planning its program.

ATOMIC ENERGY COMMISSION
DIVISION OF INTERNATIONAL AFFAIRS

2/15/60

STATUS OF AGREEMENTS FOR COOPERATION IN THE CIVIL USES OF ATOMIC ENERGY AND SPECIAL AGREEMENTS

Cumulative Numbers Countries	Agreements	Country	Scope of Exchange	Effective Date of Basic Agreement
1	1	Argentina	Research	Jul 29, 1955
2	2	*Australia	Research & Power	May 28, 1957
3	3	Austria	Research	Jan 25, 1960
4	4	*Belgium	**Research & Power	Jul 21, 1955
5	5	Brazil	**Research	Aug 3, 1955
6	6	*Canada	**Research & Power	Jul 21, 1955
7	7	Chile	Research	Aug 8, 1955
8	8	China, Rep. of	**Research	Jul 18, 1955
9	9	Colombia	Research	Jul 19, 1955
10	10	Cuba	Research	Oct 10, 1957
11	11	Denmark	**Research	Jul 25, 1955
12	12	Dominican Rep	Research	Dec 21, 1956
13	13	Ecuador	Research	Feb 6, 1958
14	14	France	**Research & Power	Nov 20, 1956
15	15	Germany, Fed. Rep.	**Research & Power	Aug 7, 1957
	16	W. Berlin, City	Research	Aug 1, 1957
16	17	Greece	Research	Aug 4, 1955
17	18	Guatemala	Research	Apr 22, 1957
18	19	Iran	Research	Apr 27, 1959
19	20	Ireland	Research	Jul 9, 1958
20	21	Israel	**Research	Jul 12, 1955
21	22	Italy	Research & Power	Apr 15, 1958
22	23	Japan	**Research & Power	Dec 5, 1958
23	24	Korea, Rep. of	**Research	Feb 3, 1956
24	25	Lebanon	Research	Jul 18, 1955
25	26	*Netherlands	**Research & Power	Aug 8, 1957
26	27	New Zealand	Research	Aug 29, 1956
27	28	Nicaragua	Research	Mar 7, 1958
28	29	Norway	Research & Power	Jun 10, 1957
29	30	Pakistan	Research	Aug 11, 1955
30	31	Peru	Research	Jan 25, 1956
31	32	Philippines	Research	Jul 27, 1955
32	33	Portugal	**Research	Jul 21, 1955
33	34	South Africa	Research & Power	Aug 22, 1957
34	35	Spain	Research & Power	Feb 12, 1958
35	36	Sweden	**Research	Jan 18, 1956
36	37	Switzerland	Research	Jul 18, 1955
	38	*Switzerland	**Power	Jan 29, 1957
37	39	Thailand	**Research	Mar 13, 1956
38	40	Turkey	Research	Jun 10, 1955
39	41	*United Kingdom	**Research & Power	Jul 21, 1955
40	42	Uruguay	Research	Jan 13, 1956
41	43	Venetuela	Research & Power	Feb 9, 1960
42	44	Viet-Nam	Research	Jul 1, 1959

SPECIAL AGREEMENTS

1. European Atomic Energy Community (EURATOM)	Joint Nuclear Power Program . .	Feb 18, 1959
2. International Atomic Energy Agency (IAEA)	Supply of Materials, etc. . .	Aug 7, 1959

MUTUAL DEFENSE PURPOSES AGREEMENTS

1. Australia	Aug 14, 1957
2. Canada *	Jul 27, 1959
3. France	Jul 20, 1959
4. Germany, Fed. Rep. *	Jul 27, 1959
5. Greece *	Aug 11, 1959
6. Netherlands *	Jul 27, 1959
7. Turkey *	Jul 27, 1959
8. United Kingdom *	Aug 4, 1958
(Amendment to U. K. Agreement) *	Jul 20, 1959

SUMMARY:

In effect: 30 research and 14 power agreements with 42 countries and West Berlin, 8 Mutual Defense Purposes Agreements, and 2 special agreements (IAEA and EURATOM). Signed and awaiting completion of ratification are research and/or power agreements with Brazil, Costa Rica, Cuba, Iraq, Peru, and Panama.

* Classified Agreements.
** Denotes Agreement has been amended.

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